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(54) **UPLINK DOWNLINK RESOURCE PARTITIONS IN ACCESS POINT DESIGN**

(75) Inventors: **Saurabh Tavildar**, Jersey City, NJ (US); **Junyi Li**, Chester, CA (US); **Thomas J. Richardson**, South Orange, NJ (US); **Nilesh N. Khude**, Bridgewater, NJ (US)

(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

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H04W 16/10	(2009.01)
H04W 72/08	(2009.01)
H04W 72/04	(2009.01)

(52) **U.S. Cl.**

CPC ***H04W 16/10*** (2013.01); ***H04W 72/082*** (2013.01); *H04W 72/0406* (2013.01)

(58) **Field of Classification Search**

CPC H04W 72/04; H04W 28/00; H04W 88/08
USPC 370/328–329, 330, 335–338, 340–345, 370/347, 436–437, 441–444, 458, 462, 465, 370/468, 479–480
See application file for complete search history.

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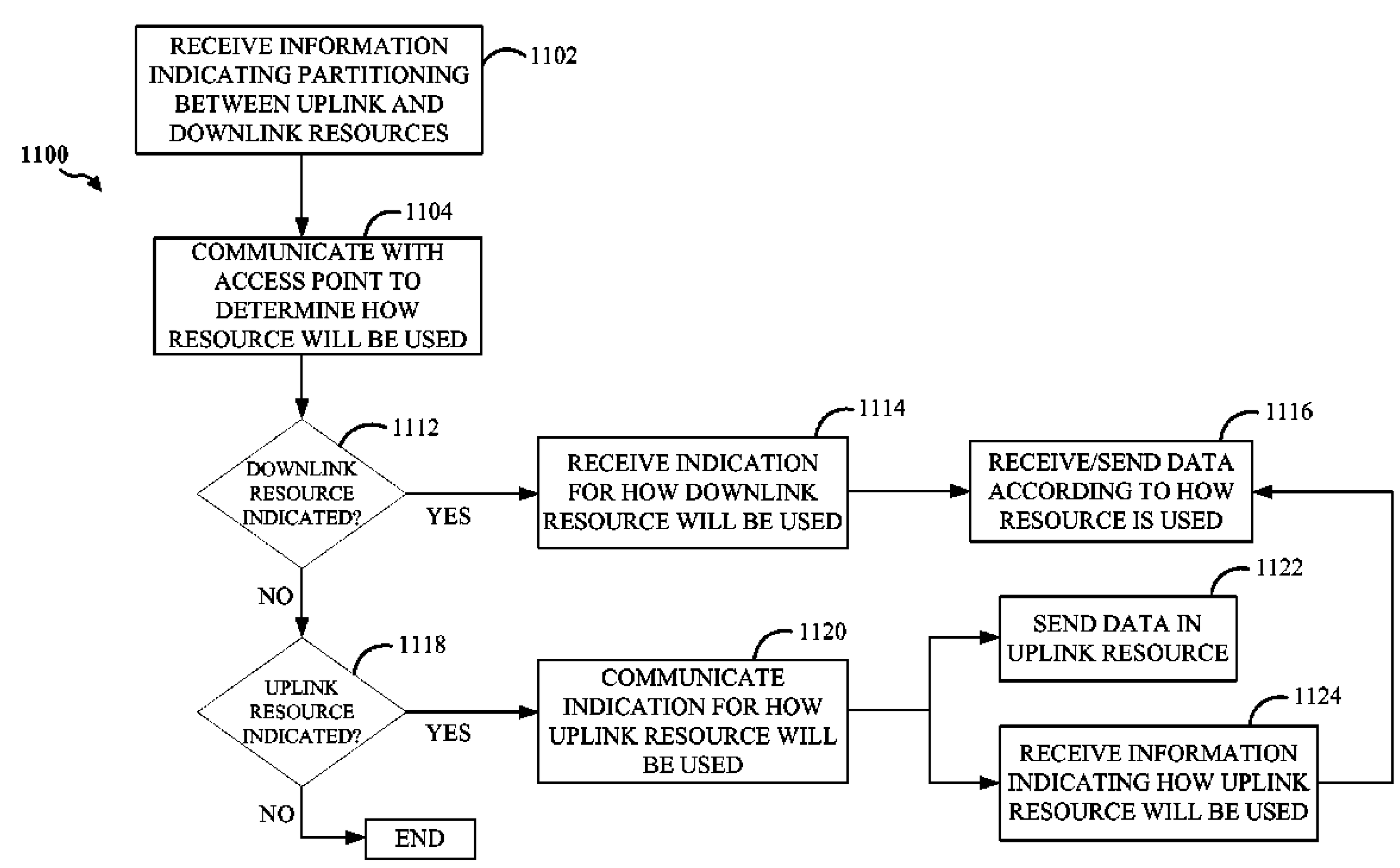
Primary Examiner — Kevin Mew

(74) *Attorney, Agent, or Firm* — James K. O'Hare

(57) **ABSTRACT**

A method, an apparatus, and a computer program product for wireless communication are provided in which information indicating a partitioning between uplink and downlink resources is received, and communication with an access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink is performed. Accordingly, a synchronous network may be provided where partitioning of uplink-downlink resources may be dynamically selected, which is more efficient than a synchronous network where uplink-downlink resource partitioning is global and semi-static.

41 Claims, 14 Drawing Sheets



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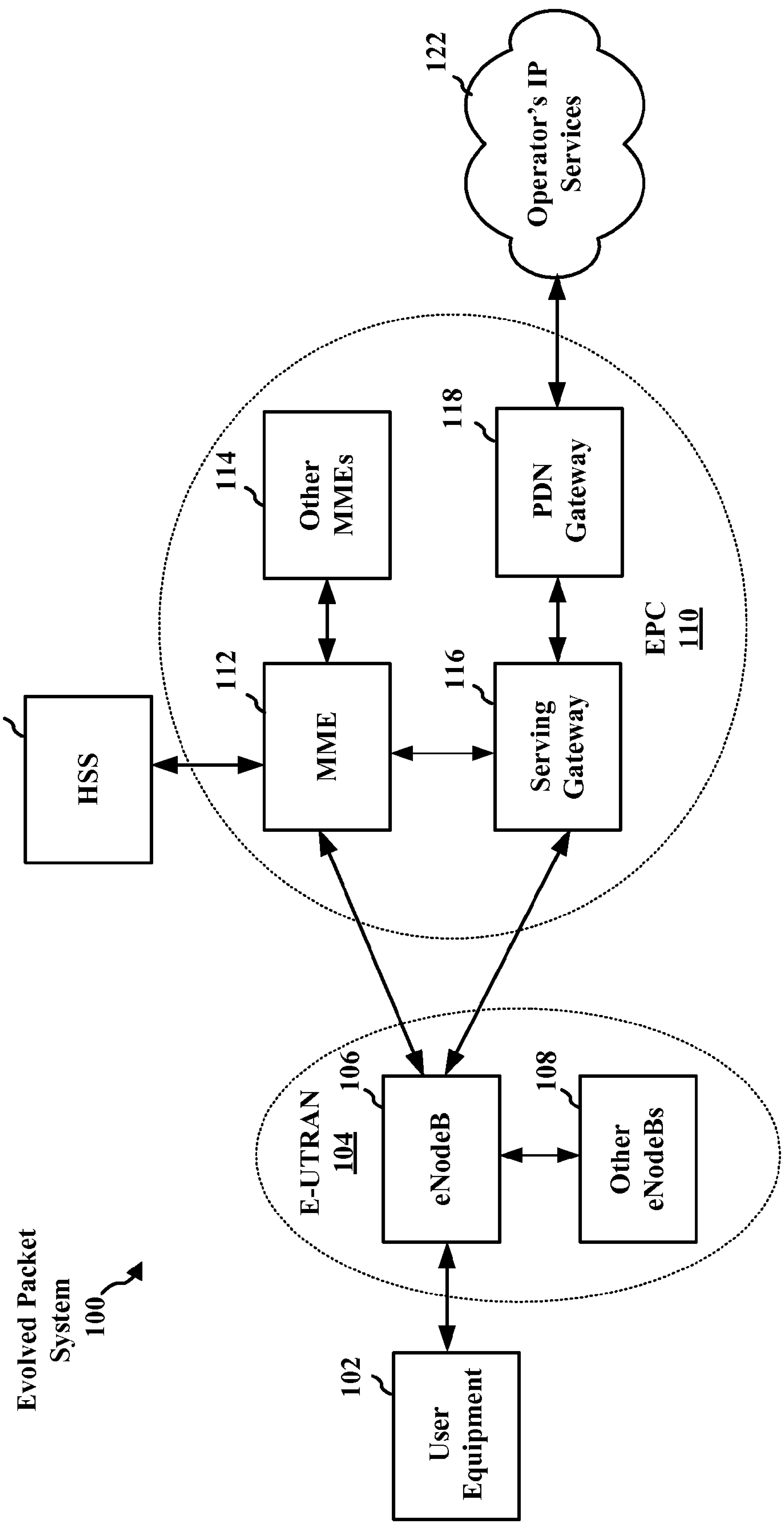

Evolved Packet System
100
102
User Equipment
E-UTRAN
104
106
eNodeB
108
Other eNodeBs
120
HSS
112
MME
114
Other MMEs
116
Serving Gateway
118
PDN Gateway
EPC
110
122
Operator's IP Services

FIG. 1

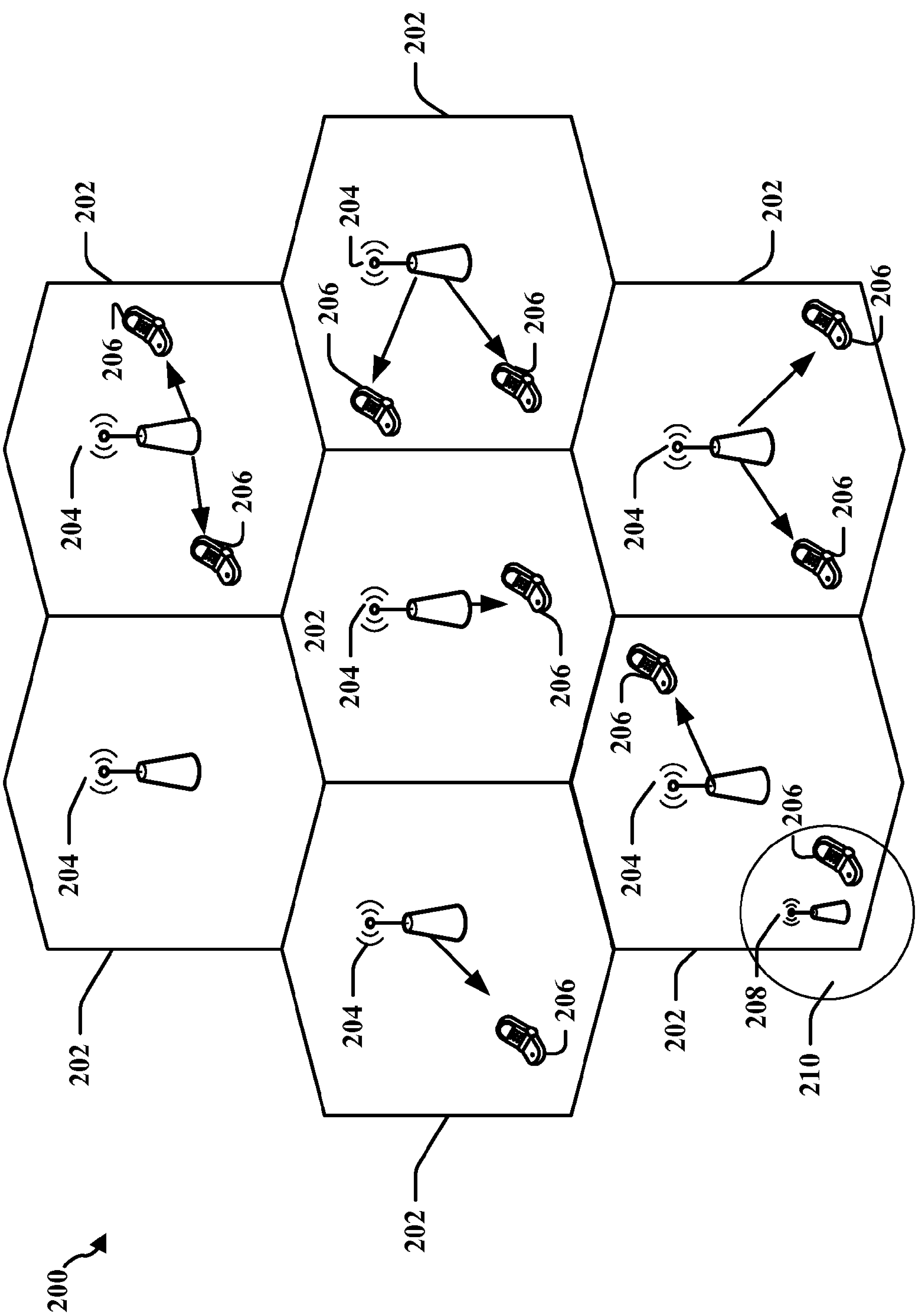


FIG. 2

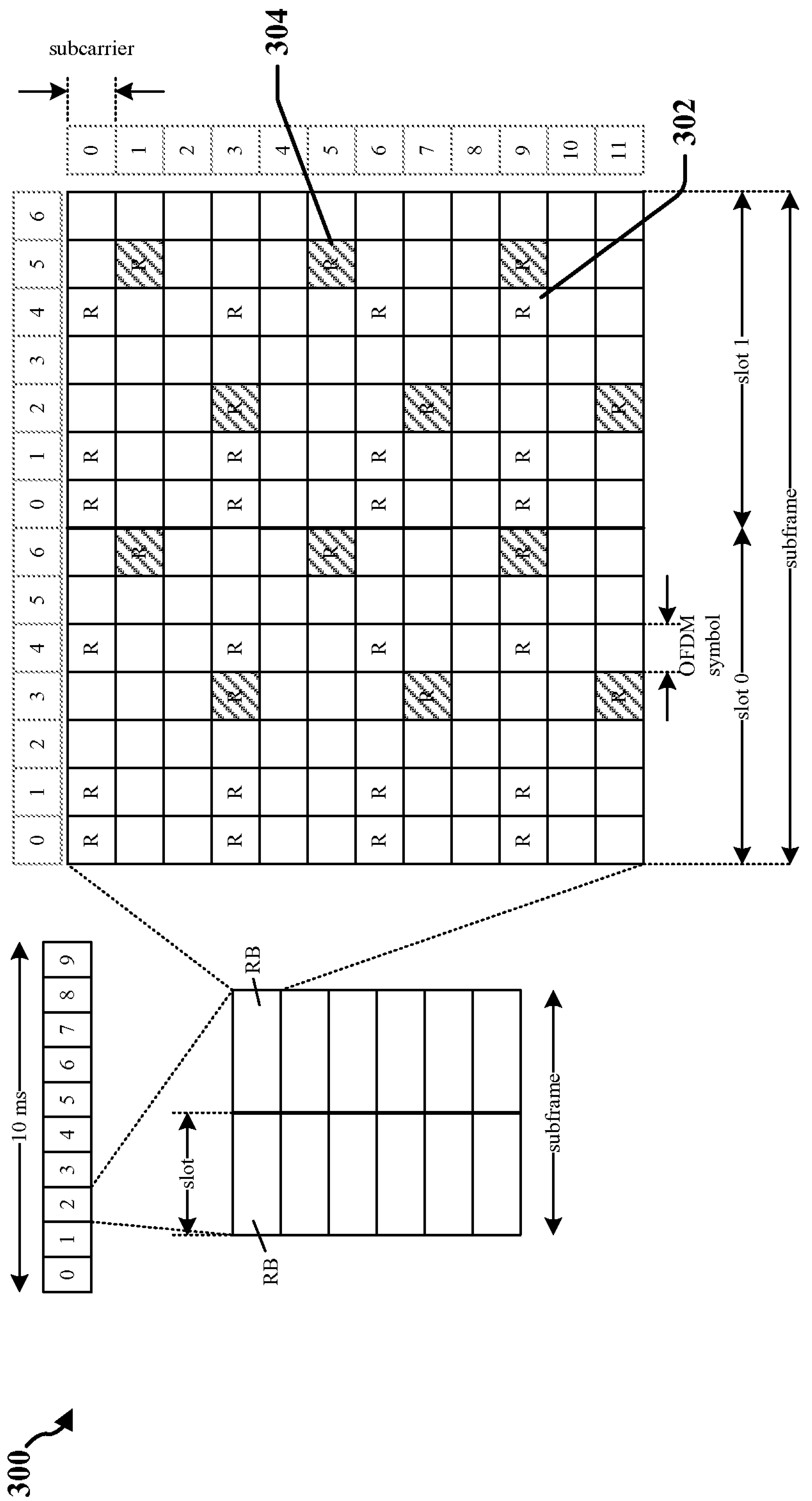

subcarrier
304
302
OFDM symbol
slot 0
slot 1
subframe
RB
RB
slot
subframe
10 ms
300

FIG. 3

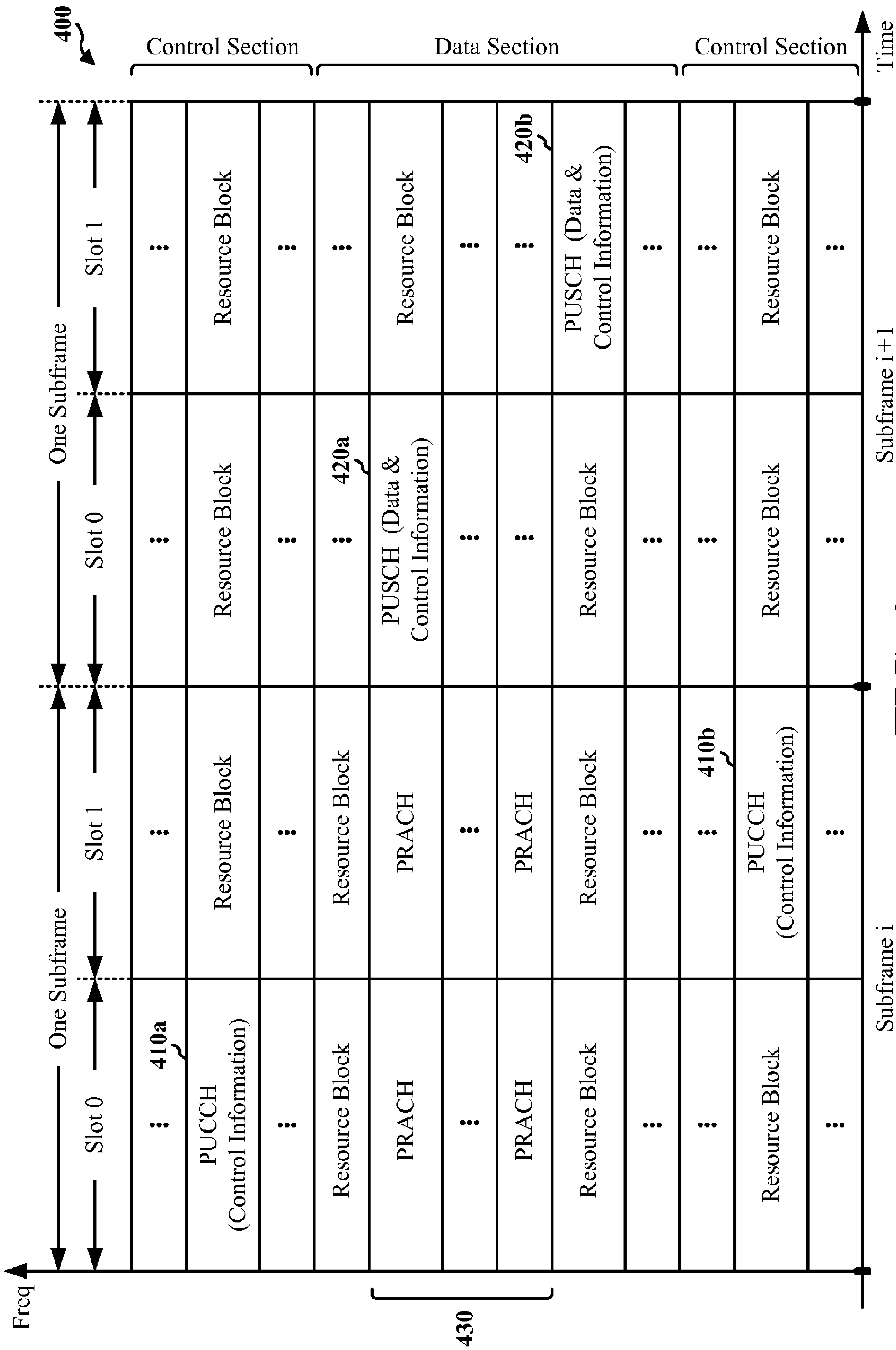

400
Control Section
Data Section
Control Section
Time
Freq
One Subframe
One Subframe
Slot 0
Slot 1
Slot 0
Slot 1
PUCCH (Control Information)
410a
410b
PUCCH (Control Information)
PRACH
PRACH
Resource Block
PUSCH (Data & Control Information)
420a
420b
PUSCH (Data & Control Information)
430
Subframe i
Subframe i+1

FIG. 4

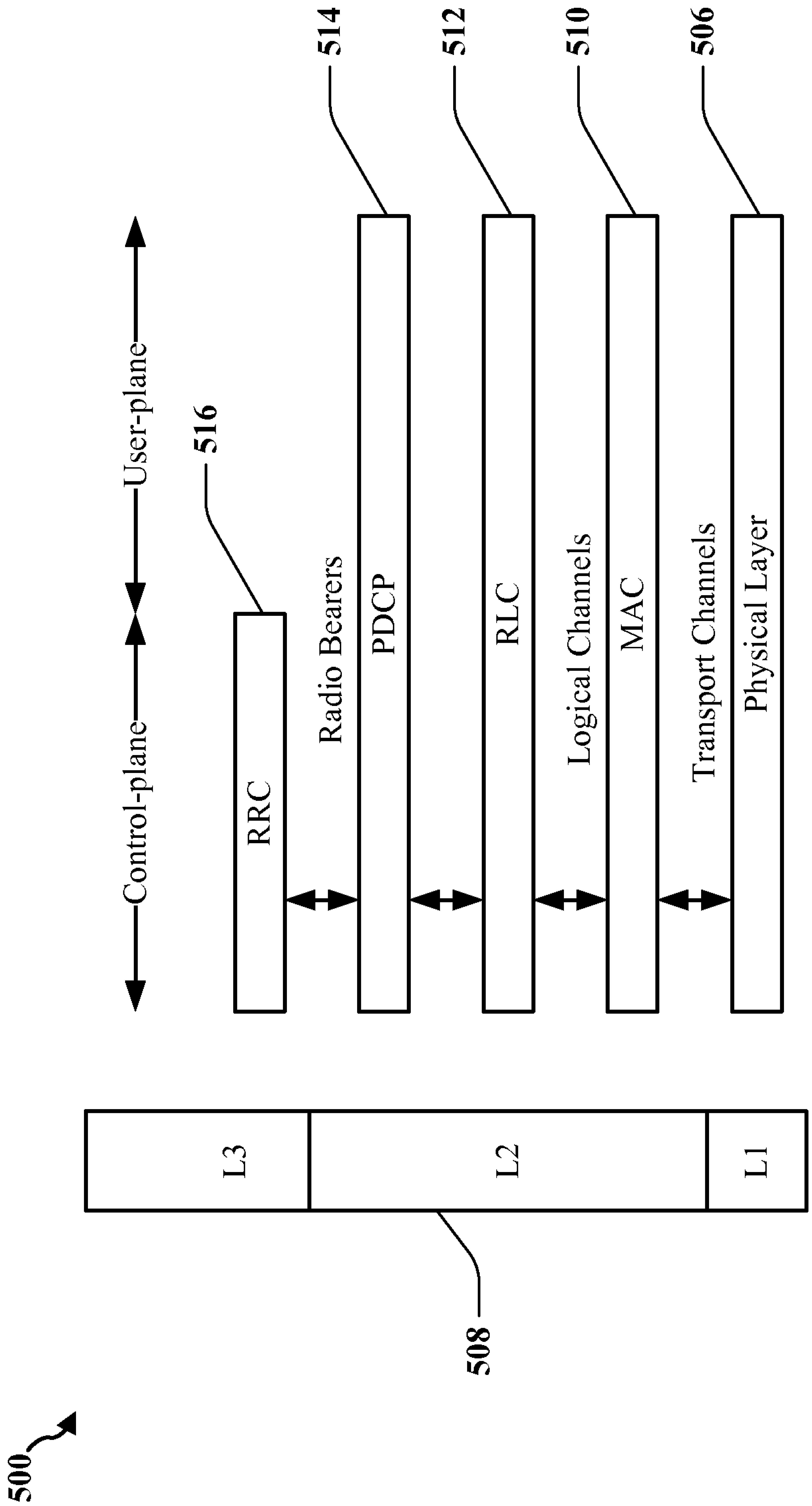

514
512
510
506
User-plane
Control-plane
516
RRC
Radio Bearers
PDCP
RLC
Logical Channels
MAC
Transport Channels
Physical Layer
L3
L2
L1
508
500

FIG. 5

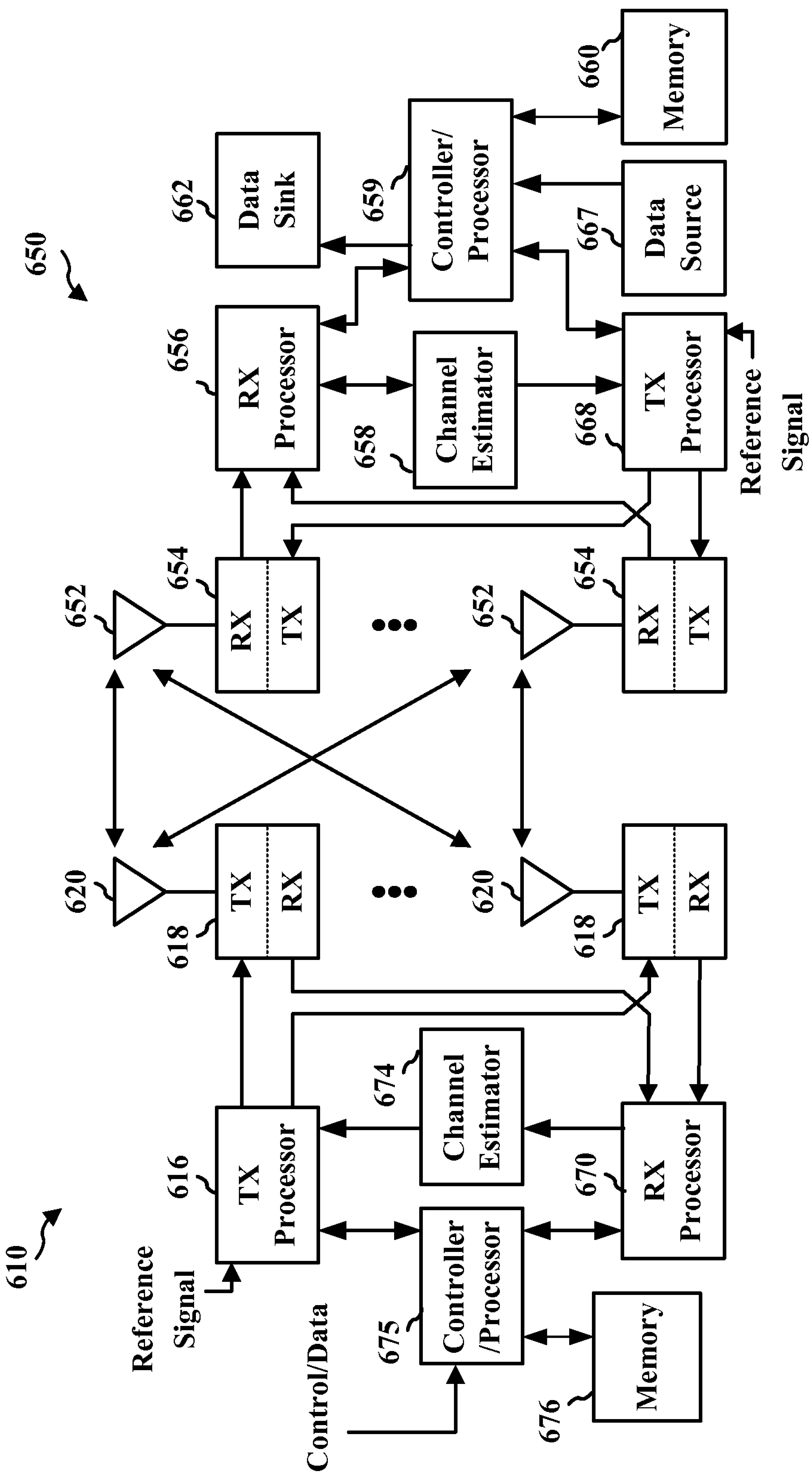

650
662
Data Sink
659
Controller/ Processor
660
Memory
667
Data Source
656
RX Processor
658
Channel Estimator
668
TX Processor
Reference Signal
654
RX
TX
652
620
618
TX
RX
610
616
TX Processor
674
Channel Estimator
670
RX Processor
Reference Signal
675
Controller /Processor
676
Memory
Control/Data

FIG. 6

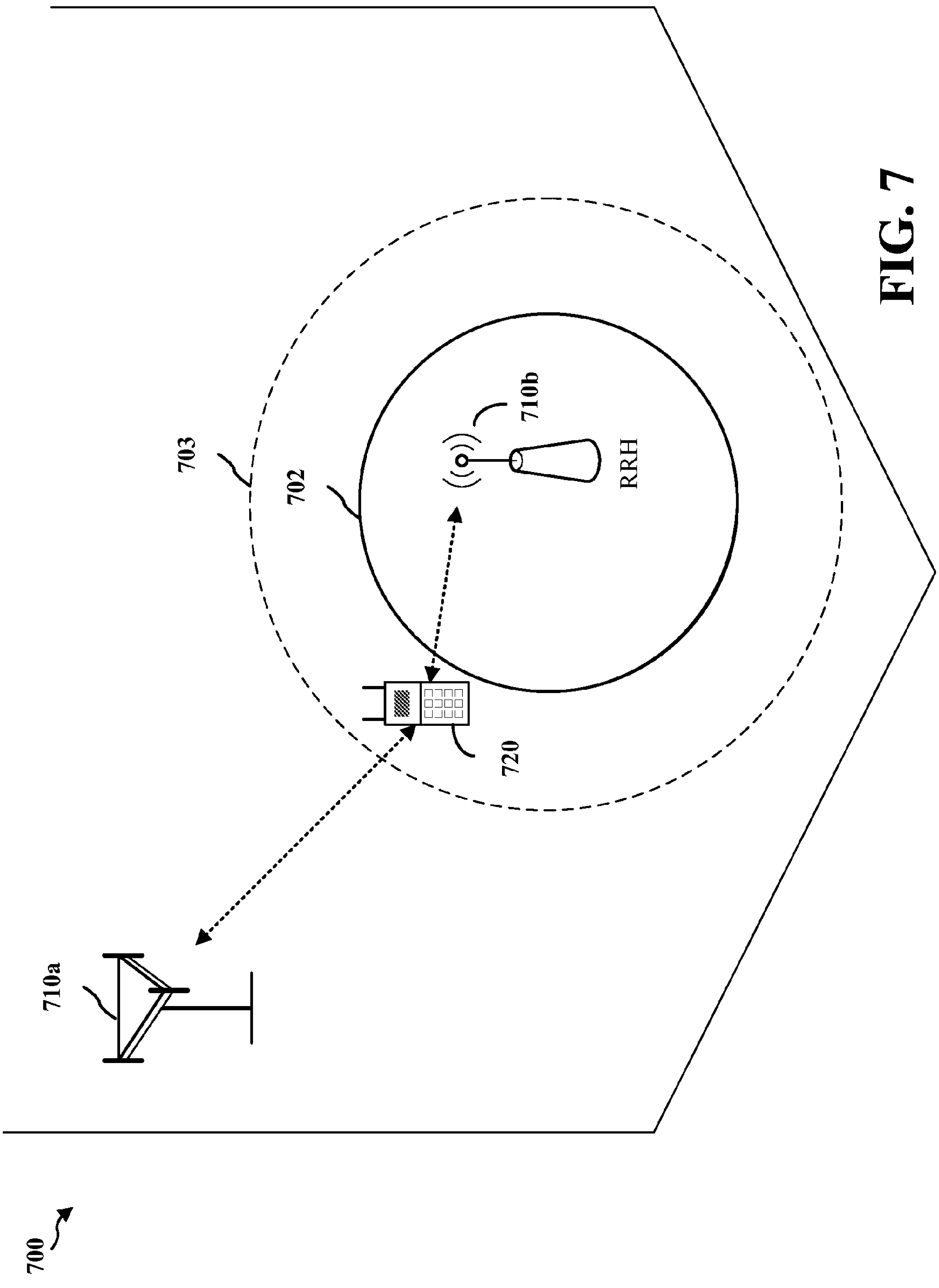


FIG. 7

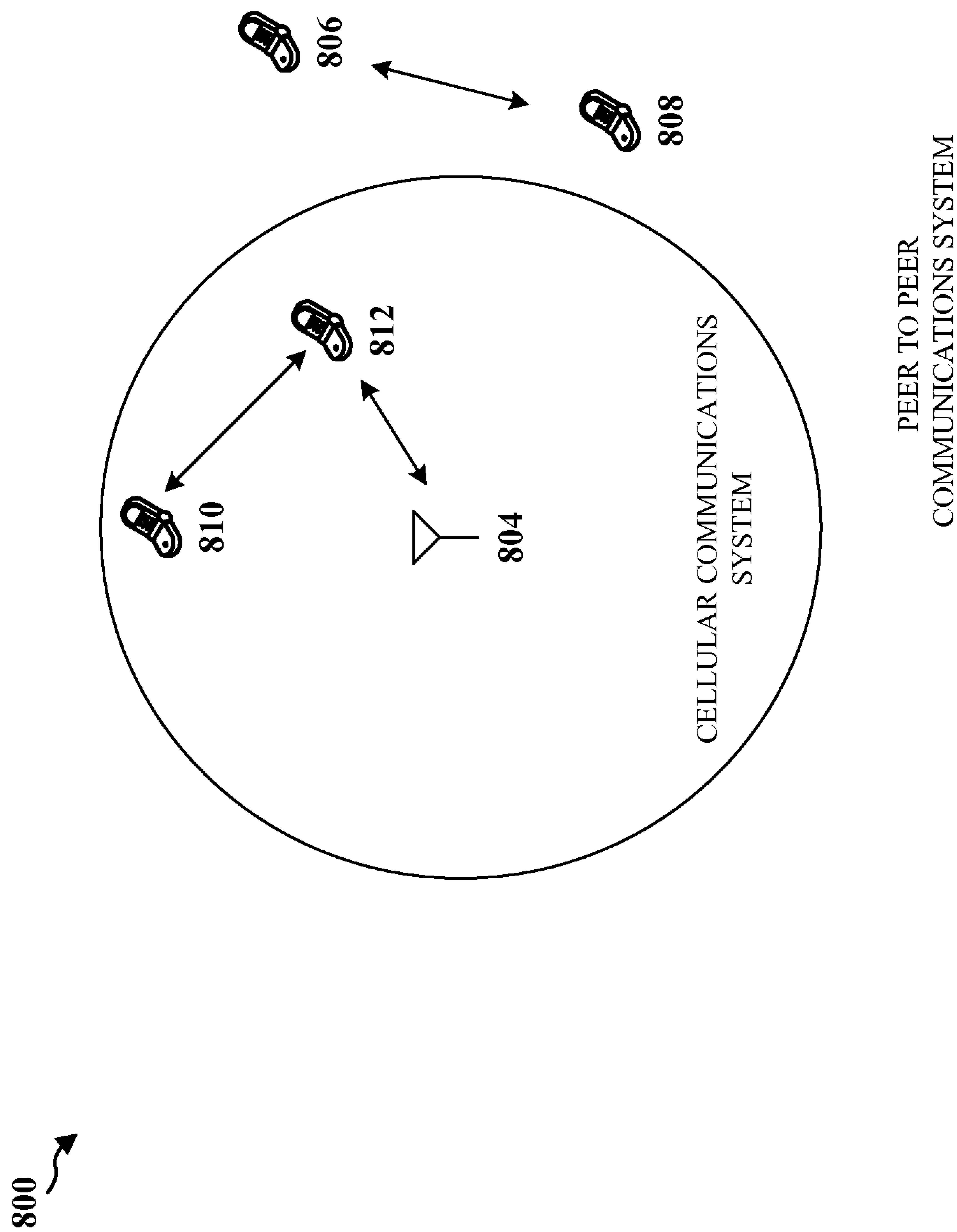

806
808
PEER TO PEER
COMMUNICATIONS SYSTEM
812
810
804
CELLULAR COMMUNICATIONS
SYSTEM
800

FIG. 8

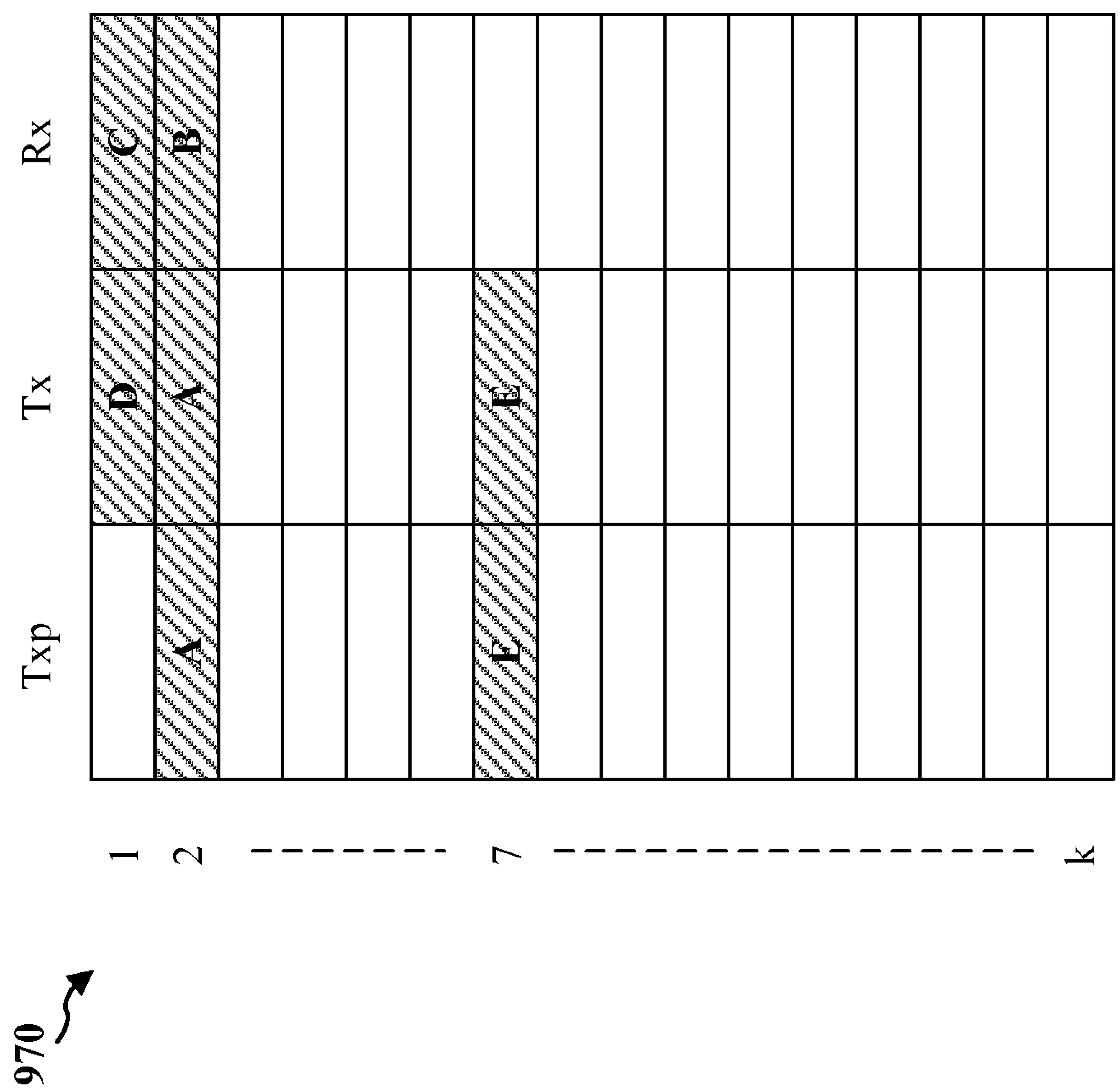


FIG. 9B

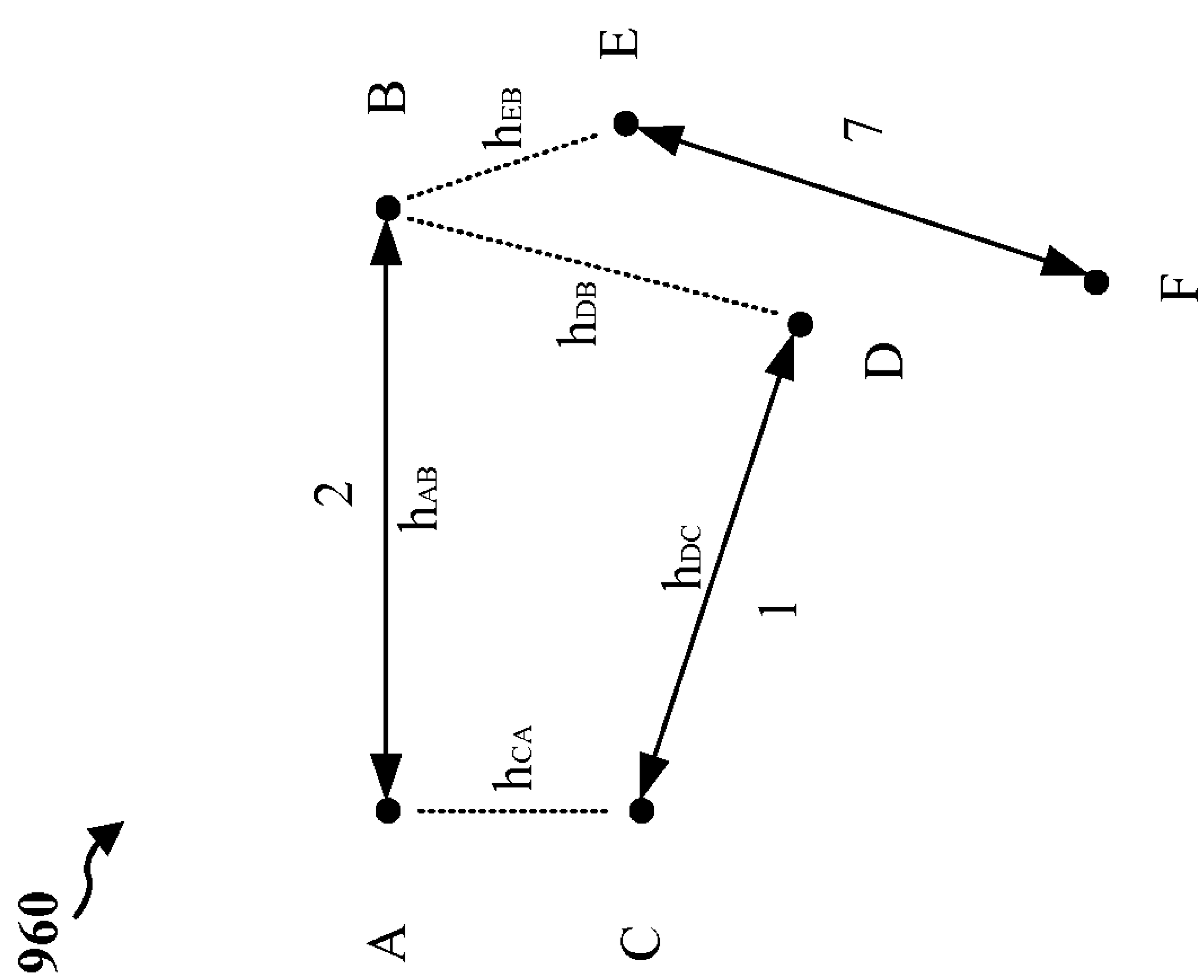


FIG. 9A

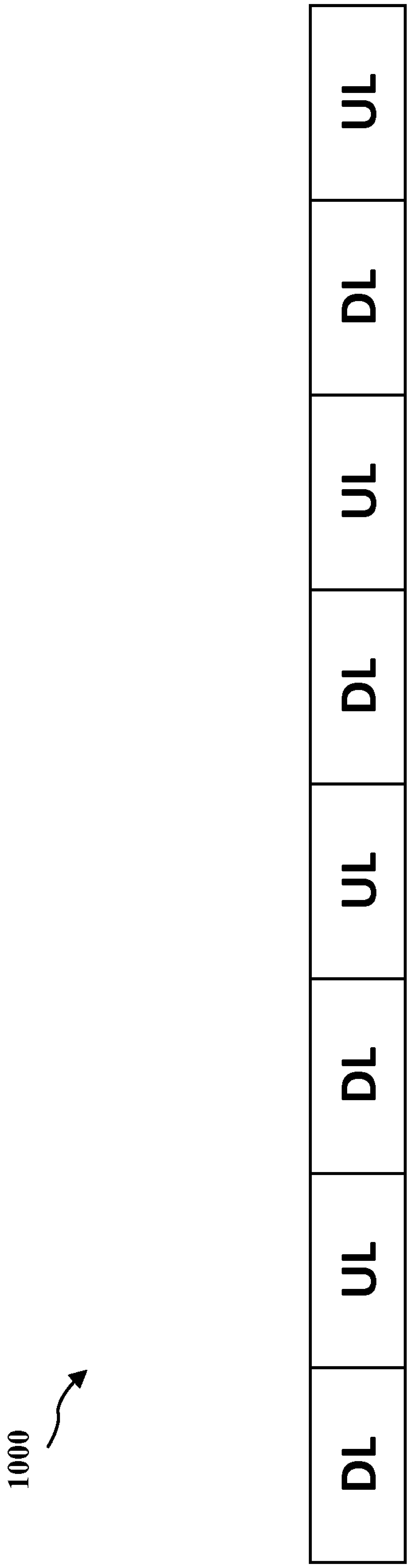


FIG. 10

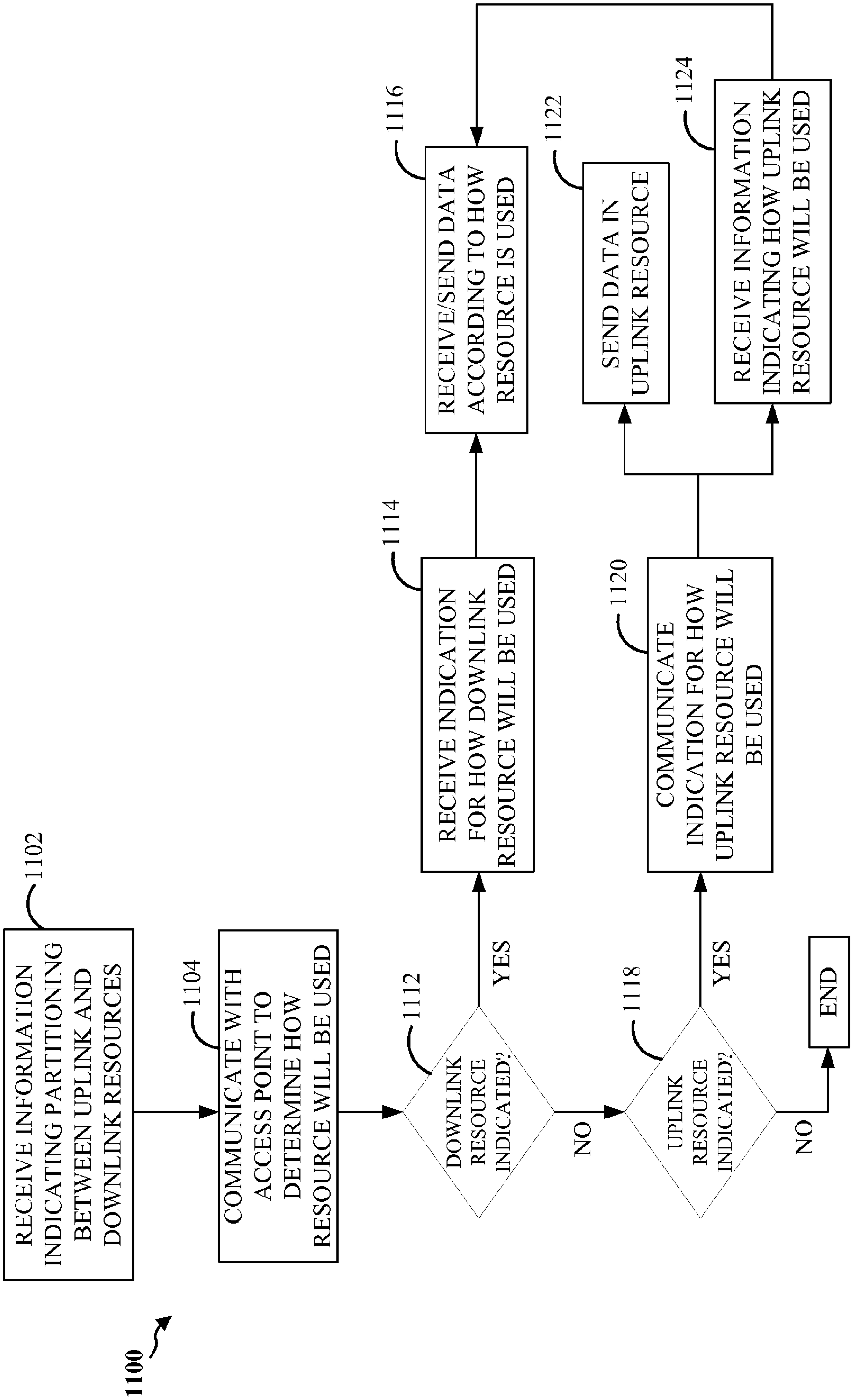

1100
RECEIVE INFORMATION INDICATING PARTITIONING BETWEEN UPLINK AND DOWNLINK RESOURCES
1102
COMMUNICATE WITH ACCESS POINT TO DETERMINE HOW RESOURCE WILL BE USED
1104
DOWNLINK RESOURCE INDICATED?
1112
YES
NO
RECEIVE INDICATION FOR HOW DOWNLINK RESOURCE WILL BE USED
1114
RECEIVE/SEND DATA ACCORDING TO HOW RESOURCE IS USED
1116
UPLINK RESOURCE INDICATED?
1118
YES
NO
COMMUNICATE INDICATION FOR HOW UPLINK RESOURCE WILL BE USED
1120
SEND DATA IN UPLINK RESOURCE
1122
RECEIVE INFORMATION INDICATING HOW UPLINK RESOURCE WILL BE USED
1124
END

FIG. 11

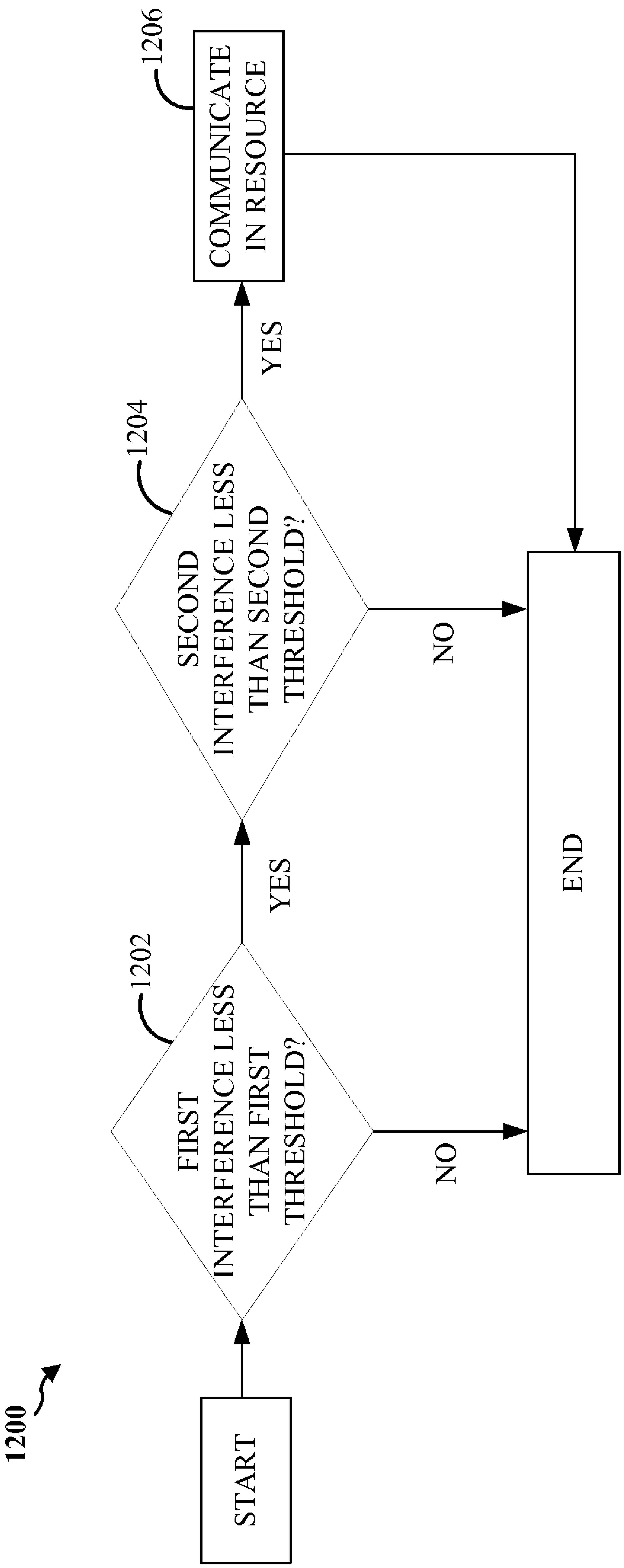
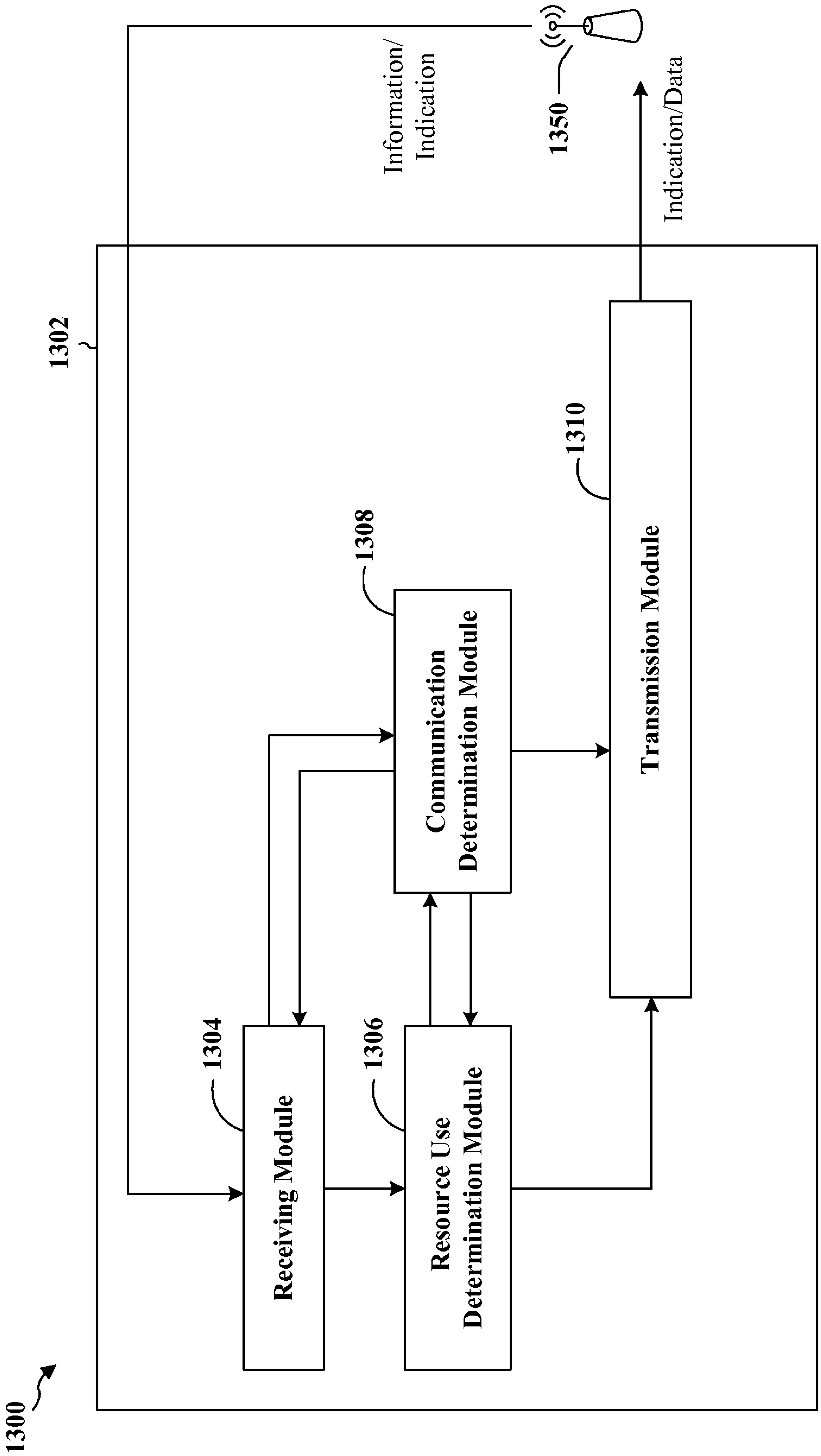

1200
START
1202
FIRST INTERFERENCE LESS THAN FIRST THRESHOLD?
YES
NO
1204
SECOND INTERFERENCE LESS THAN SECOND THRESHOLD?
YES
NO
1206
COMMUNICATE IN RESOURCE
END

FIG. 12



1300
1302
1304
Receiving Module
1306
Resource Use Determination Module
1308
Communication Determination Module
1310
Transmission Module
1350
Information/ Indication
Indication/Data

FIG. 13

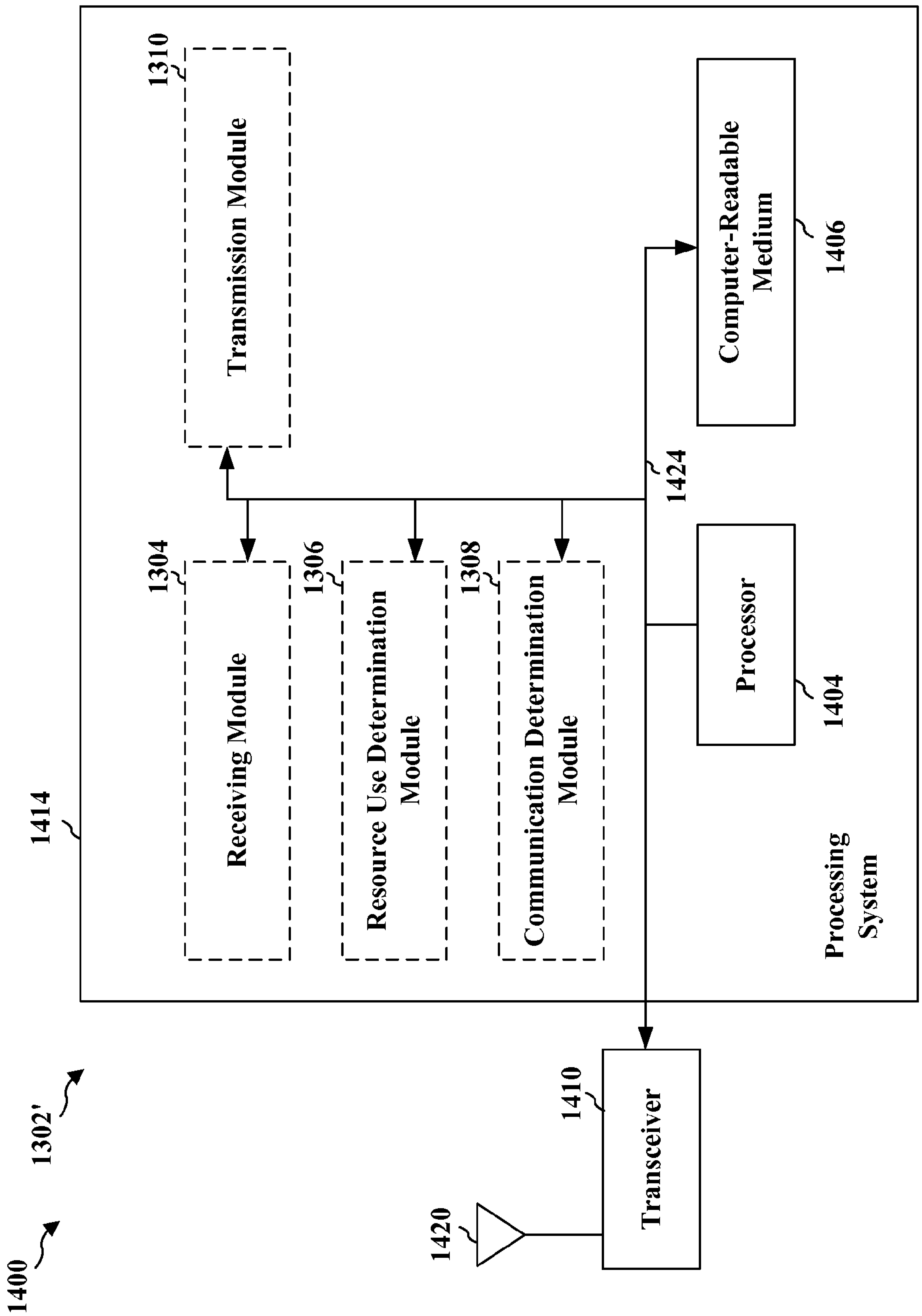

1400
1302'
1414
1310
Transmission Module
1304
Receiving Module
1306
Resource Use Determination Module
1308
Communication Determination Module
1424
Computer-Readable Medium
1406
Processor
1404
Processing System
1410
Transceiver
1420

FIG. 14

UPLINK DOWNLINK RESOURCE PARTITIONS IN ACCESS POINT DESIGN

BACKGROUND

1. Field

The present disclosure relates generally to communication systems, and more particularly, to partitioning between uplink and downlink resources used for communication.

2. Background

Wireless communication systems are widely deployed to provide various telecommunication services such as telephony, video, data, messaging, and broadcasts. Typical wireless communication systems may employ multiple-access technologies capable of supporting communication with multiple users by sharing available system resources (e.g., bandwidth, transmit power). Examples of such multiple-access technologies include code division multiple access (CDMA) systems, time division multiple access (TDMA) systems, frequency division multiple access (FDMA) systems, orthogonal frequency division multiple access (OFDMA) systems, single-carrier frequency divisional multiple access (SC-FDMA) systems, and time division synchronous code division multiple access (TD-SCDMA) systems.

These multiple access technologies have been adopted in various telecommunication standards to provide a common protocol that enables different wireless devices to communicate on a municipal, national, regional, and even global level. An example of an emerging telecommunication standard is Long Term Evolution (LTE). LTE is a set of enhancements to the Universal Mobile Telecommunications System (UMTS) mobile standard promulgated by Third Generation Partnership Project (3GPP). It is designed to better support mobile broadband Internet access by improving spectral efficiency, lower costs, improve services, make use of new spectrum, and better integrate with other open standards using OFDMA on the downlink (DL), SC-FDMA on the uplink (UL), and multiple-input multiple-output (MIMO) antenna technology. However, as the demand for mobile broadband access continues to increase, there exists a need for further improvements in LTE technology. Preferably, these improvements should be applicable to other multi-access technologies and the telecommunication standards that employ these technologies.

SUMMARY

In a synchronous time division duplex (TDD) access network, uplink (UL) and downlink (DL) resource partitioning is global and semi-static. That is, all access points (APs) of such a network are synchronous and adhere to a global UL-DL resource partitioning pattern. This may cause inefficient resource utilization. For example, a network may be partitioned to have a percentage of its total available resources dedicated for uplink transmissions. However, if there is no uplink traffic for some of the APs of the network, the partitioned uplink resources are wasted. Moreover, because of the semi-static resource partitioning, the uplink and downlink resources experience overload and/or under-utilization due to traffic patterns changing over time.

Accordingly, a synchronous network is provided where partitioning of uplink-downlink resources may be dynamically selected, which is more efficient than the synchronous network having the global and semi-static uplink-downlink resource partitioning. In an aspect of the disclosure, a method, an apparatus, and a computer program product for wireless communication are provided in which information indicating a tentative partitioning between uplink and downlink resources is received, and communication with an access point to determine at least one of whether a downlink resource will be locally used for uplink or whether an uplink resource will be locally used for downlink is performed before using each data resource.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating an example of a network architecture.

FIG. **2** is a diagram illustrating an example of an access network.

FIG. **3** is a diagram illustrating an example of a DL frame structure in LTE.

FIG. **4** is a diagram illustrating an example of an UL frame structure in LTE.

FIG. **5** is a diagram illustrating an example of a radio protocol architecture for the user and control planes.

FIG. **6** is a diagram illustrating an example of an evolved Node B and user equipment in an access network.

FIG. **7** is a diagram illustrating a range expanded cellular region in a heterogeneous network.

FIG. **8** is a drawing of an exemplary peer-to-peer communications system.

FIG. **9**A is a first diagram for illustrating an exemplary connection scheduling signaling scheme for wireless devices.

FIG. **9**B is a second diagram for illustrating an exemplary connection scheduling signaling scheme for wireless devices.

FIG. **10** is a diagram illustrating a system wide UL-DL resource partitioning common to all access points (APs) of a synchronous time division duplexing (TDD) access network.

FIG. **11** is a flow chart of a method of wireless communication.

FIG. **12** is a flow chart of a method of wireless communication.

FIG. **13** is a conceptual data flow diagram illustrating the data flow between different modules/means/components in an exemplary apparatus.

FIG. **14** is a diagram illustrating an example of a hardware implementation for an apparatus employing a processing system.

DETAILED DESCRIPTION

The detailed description set forth below in connection with the appended drawings is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well known structures and components are shown in block diagram form in order to avoid obscuring such concepts.

Several aspects of telecommunication systems will now be presented with reference to various apparatus and methods. These apparatus and methods will be described in the following detailed description and illustrated in the accompanying drawings by various blocks, modules, components, circuits, steps, processes, algorithms, etc. (collectively referred to as "elements"). These elements may be implemented using electronic hardware, computer software, or any combination thereof. Whether such elements are implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system.

By way of example, an element, or any portion of an element, or any combination of elements may be implemented with a "processing system" that includes one or more processors. Examples of processors include microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), state machines, gated logic, discrete hardware circuits, and other suitable hardware configured to perform the various functionality described throughout this disclosure. One or more processors in the processing system may execute software. Software shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, functions, etc., whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise.

Accordingly, in one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or encoded as one or more instructions or code on a computer-readable medium. Computer-readable media includes computer storage media. Storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

FIG. **1** is a diagram illustrating an LTE network architecture **100**. The LTE network architecture **100** may be referred to as an Evolved Packet System (EPS) **100**. The EPS **100** may include one or more user equipment (UE) **102**, an Evolved UMTS Terrestrial Radio Access Network (E-UTRAN) **104**, an Evolved Packet Core (EPC) **110**, a Home Subscriber Server (HSS) **120**, and an Operator's IP Services **122**. The EPS can interconnect with other access networks, but for simplicity those entities/interfaces are not shown. As shown, the EPS provides packet-switched services, however, as those skilled in the art will readily appreciate, the various concepts presented throughout this disclosure may be extended to networks providing circuit-switched services.

The E-UTRAN includes the evolved Node B (eNB) **106** and other eNBs **108**. The eNB **106** provides user and control planes protocol terminations toward the UE **102**. The eNB **106** may be connected to the other eNBs **108** via an X2 interface (e.g., backhaul). The eNB **106** may also be referred to as a base station, a base transceiver station, a radio base station, a radio transceiver, a transceiver function, a basic service set (BSS), an extended service set (ESS), or some other suitable terminology. The eNB **106** provides an access point to the EPC **110** for a UE **102**. Examples of UEs **102** include a cellular phone, a smart phone, a session initiation protocol (SIP) phone, a laptop, a personal digital assistant (PDA), a satellite radio, a global positioning system, a multimedia device, a video device, a digital audio player (e.g., MP3 player), a camera, a game console, or any other similar functioning device. The UE **102** may also be referred to by those skilled in the art as a mobile station, a subscriber station, a mobile unit, a subscriber unit, a wireless unit, a remote unit, a mobile device, a wireless device, a wireless communications device, a remote device, a mobile subscriber station, an access terminal, a mobile terminal, a wireless terminal, a remote terminal, a handset, a user agent, a mobile client, a client, or some other suitable terminology.

The eNB **106** is connected by an S1 interface to the EPC **110**. The EPC **110** includes a Mobility Management Entity (MME) **112**, other MMEs **114**, a Serving Gateway **116**, and a Packet Data Network (PDN) Gateway **118**. The MME **112** is the control node that processes the signaling between the UE **102** and the EPC **110**. Generally, the MME **112** provides bearer and connection management. All user IP packets are transferred through the Serving Gateway **116**, which itself is connected to the PDN Gateway **118**. The PDN Gateway **118** provides UE IP address allocation as well as other functions. The PDN Gateway **118** is connected to the Operator's IP Services **122**. The Operator's IP Services **122** may include the Internet, the Intranet, an IP Multimedia Subsystem (IMS), and a PS Streaming Service (PSS).

FIG. **2** is a diagram illustrating an example of an access network **200** in an LTE network architecture. In this example, the access network **200** is divided into a number of cellular regions (cells) **202**. One or more lower power class eNBs **208** may have cellular regions **210** that overlap with one or more of the cells **202**. A lower power class eNB **208** may be referred to as a remote radio head (RRH). The lower power class eNB **208** may be a femto cell (e.g., home eNB (HeNB)), pico cell, or micro cell. The macro eNBs **204** are each assigned to a respective cell **202** and are configured to provide an access point to the EPC **110** for all the UEs **206** in the cells **202**. There is no centralized controller in this example of an access network **200**, but a centralized controller may be used in alternative configurations. The eNBs **204** are responsible for all radio related functions including radio bearer control, admission control, mobility control, scheduling, security, and connectivity to the serving gateway **116**.

The modulation and multiple access scheme employed by the access network **200** may vary depending on the particular telecommunications standard being deployed. In LTE applications, OFDM is used on the DL and SC-FDMA is used on the UL to support both frequency division duplexing (FDD) and time division duplexing (TDD). As those skilled in the art will readily appreciate from the detailed description to follow, the various concepts presented herein are well suited for LTE applications. However, these concepts may be readily extended to other telecommunication standards employing other modulation and multiple access techniques. By way of example, these concepts may be extended to Evolution-Data Optimized (EV-DO) or Ultra Mobile Broadband (UMB). EV-DO and UMB are air interface standards promulgated by the 3rd Generation Partnership Project 2 (3GPP2) as part of the CDMA2000 family of standards and employs CDMA to provide broadband Internet access to mobile stations. These concepts may also be extended to Universal Terrestrial Radio Access (UTRA) employing Wideband-CDMA (W-CDMA) and other variants of CDMA, such as TD-SCDMA; Global System for Mobile Communications (GSM) employing TDMA; and Evolved UTRA (E-UTRA), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, and Flash-OFDM employing OFDMA. UTRA, E-UTRA, UMTS, LTE and GSM are described in documents from the 3GPP organization. CDMA2000 and UMB are described in documents from the 3GPP2 organization. The actual wireless communication standard and the multiple access technology employed will depend on the specific application and the overall design constraints imposed on the system.

The eNBs **204** may have multiple antennas supporting MIMO technology. The use of MIMO technology enables the eNBs **204** to exploit the spatial domain to support spatial multiplexing, beamforming, and transmit diversity. Spatial multiplexing may be used to transmit different streams of data simultaneously on the same frequency. The data steams may be transmitted to a single UE **206** to increase the data rate or to multiple UEs **206** to increase the overall system capacity. This is achieved by spatially precoding each data stream (i.e., applying a scaling of an amplitude and a phase) and then transmitting each spatially precoded stream through multiple transmit antennas on the DL. The spatially precoded data streams arrive at the UE(s) **206** with different spatial signatures, which enables each of the UE(s) **206** to recover the one or more data streams destined for that UE **206**. On the UL, each UE **206** transmits a spatially precoded data stream, which enables the eNB **204** to identify the source of each spatially precoded data stream.

Spatial multiplexing is generally used when channel conditions are good. When channel conditions are less favorable, beamforming may be used to focus the transmission energy in one or more directions. This may be achieved by spatially precoding the data for transmission through multiple antennas. To achieve good coverage at the edges of the cell, a single stream beamforming transmission may be used in combination with transmit diversity.

In the detailed description that follows, various aspects of an access network will be described with reference to a MIMO system supporting OFDM on the DL. OFDM is a spread-spectrum technique that modulates data over a number of subcarriers within an OFDM symbol. The subcarriers are spaced apart at precise frequencies. The spacing provides "orthogonality" that enables a receiver to recover the data from the subcarriers. In the time domain, a guard interval (e.g., cyclic prefix) may be added to each OFDM symbol to combat inter-OFDM-symbol interference. The UL may use SC-FDMA in the form of a DFT-spread OFDM signal to compensate for high peak-to-average power ratio (PAPR).

FIG. **3** is a diagram **300** illustrating an example of a DL frame structure in LTE. A frame (10 ms) may be divided into 10 equally sized sub-frames. Each sub-frame may include two consecutive time slots. A resource grid may be used to represent two time slots, each time slot including a resource block. The resource grid is divided into multiple resource elements. In LTE, a resource block contains 12 consecutive subcarriers in the frequency domain and, for a normal cyclic prefix in each OFDM symbol, 7 consecutive OFDM symbols in the time domain, or 84 resource elements. For an extended cyclic prefix, a resource block contains 6 consecutive OFDM symbols in the time domain and has 72 resource elements. Some of the resource elements, as indicated as R **302**, **304**, include DL reference signals (DL-RS). The DL-RS include Cell-specific RS (CRS) (also sometimes called common RS) **302** and UE-specific RS (UE-RS) **304**. UE-RS **304** are transmitted only on the resource blocks upon which the corresponding physical DL shared channel (PDSCH) is mapped. The number of bits carried by each resource element depends on the modulation scheme. Thus, the more resource blocks that a UE receives and the higher the modulation scheme, the higher the data rate for the UE.

FIG. **4** is a diagram **400** illustrating an example of an UL frame structure in LTE. The available resource blocks for the UL may be partitioned into a data section and a control section. The control section may be formed at the two edges of the system bandwidth and may have a configurable size. The resource blocks in the control section may be assigned to UEs for transmission of control information. The data section may include all resource blocks not included in the control section. The UL frame structure results in the data section including contiguous subcarriers, which may allow a single UE to be assigned all of the contiguous subcarriers in the data section.

A UE may be assigned resource blocks **410***a*, **410***b* in the control section to transmit control information to an eNB. The UE may also be assigned resource blocks **420***a*, **420***b* in the data section to transmit data to the eNB. The UE may transmit control information in a physical UL control channel (PUCCH) on the assigned resource blocks in the control section. The UE may transmit only data or both data and control information in a physical UL shared channel (PUSCH) on the assigned resource blocks in the data section. A UL transmission may span both slots of a subframe and may hop across frequency.

A set of resource blocks may be used to perform initial system access and achieve UL synchronization in a physical random access channel (PRACH) **430**. The PRACH **430** carries a random sequence and cannot carry any UL data/signaling. Each random access preamble occupies a bandwidth corresponding to six consecutive resource blocks. The starting frequency is specified by the network. That is, the transmission of the random access preamble is restricted to certain time and frequency resources. There is no frequency hopping for the PRACH. The PRACH attempt is carried in a single subframe (1 ms) or in a sequence of few contiguous subframes and a UE can make only a single PRACH attempt per frame (10 ms).

FIG. **5** is a diagram **500** illustrating an example of a radio protocol architecture for the user and control planes in LTE. The radio protocol architecture for the UE and the eNB is shown with three layers: Layer 1, Layer 2, and Layer 3. Layer 1 (L1 layer) is the lowest layer and implements various physical layer signal processing functions. The L1 layer will be referred to herein as the physical layer **506**. Layer 2 (L2 layer) **508** is above the physical layer **506** and is responsible for the link between the UE and eNB over the physical layer **506**.

In the user plane, the L2 layer **508** includes a media access control (MAC) sublayer **510**, a radio link control (RLC) sublayer **512**, and a packet data convergence protocol (PDCP) **514** sublayer, which are terminated at the eNB on the network side. Although not shown, the UE may have several upper layers above the L2 layer **508** including a network layer (e.g., IP layer) that is terminated at the PDN gateway **118** on the network side, and an application layer that is terminated at the other end of the connection (e.g., far end UE, server, etc.).

The PDCP sublayer **514** provides multiplexing between different radio bearers and logical channels. The PDCP sublayer **514** also provides header compression for upper layer data packets to reduce radio transmission overhead, security by ciphering the data packets, and handover support for UEs between eNBs. The RLC sublayer **512** provides segmentation and reassembly of upper layer data packets, retransmission of lost data packets, and reordering of data packets to compensate for out-of-order reception due to hybrid automatic repeat request (HARQ). The MAC sublayer **510** provides multiplexing between logical and transport channels. The MAC sublayer **510** is also responsible for allocating the various radio resources (e.g., resource blocks) in one cell among the UEs. The MAC sublayer **510** is also responsible for HARQ operations.

In the control plane, the radio protocol architecture for the UE and eNB is substantially the same for the physical layer **506** and the L2 layer **508** with the exception that there is no header compression function for the control plane. The control plane also includes a radio resource control (RRC) sublayer **516** in Layer 3 (L3 layer). The RRC sublayer **516** is responsible for obtaining radio resources (i.e., radio bearers) and for configuring the lower layers using RRC signaling between the eNB and the UE.

FIG. **6** is a block diagram of an eNB **610** in communication with a UE **650** in an access network. In the DL, upper layer packets from the core network are provided to a controller/processor **675**. The controller/processor **675** implements the functionality of the L2 layer. In the DL, the controller/processor **675** provides header compression, ciphering, packet segmentation and reordering, multiplexing between logical and transport channels, and radio resource allocations to the UE **650** based on various priority metrics. The controller/processor **675** is also responsible for HARQ operations, retransmission of lost packets, and signaling to the UE **650**.

The transmit (TX) processor **616** implements various signal processing functions for the L1 layer (i.e., physical layer). The signal processing functions includes coding and interleaving to facilitate forward error correction (FEC) at the UE **650** and mapping to signal constellations based on various modulation schemes (e.g., binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK), M-phase-shift keying (M-PSK), M-quadrature amplitude modulation (M-QAM)). The coded and modulated symbols are then split into parallel streams. Each stream is then mapped to an OFDM subcarrier, multiplexed with a reference signal (e.g., pilot) in the time and/or frequency domain, and then combined together using an Inverse Fast Fourier Transform (IFFT) to produce a physical channel carrying a time domain OFDM symbol stream. The OFDM stream is spatially precoded to produce multiple spatial streams. Channel estimates from a channel estimator **674** may be used to determine the coding and modulation scheme, as well as for spatial processing. The channel estimate may be derived from a reference signal and/or channel condition feedback transmitted by the UE **650**. Each spatial stream is then provided to a different antenna **620** via a separate transmitter **618**TX. Each transmitter **618**TX modulates an RF carrier with a respective spatial stream for transmission.

At the UE **650**, each receiver **654**RX receives a signal through its respective antenna **652**. Each receiver **654**RX recovers information modulated onto an RF carrier and provides the information to the receive (RX) processor **656**. The RX processor **656** implements various signal processing functions of the L1 layer. The RX processor **656** performs spatial processing on the information to recover any spatial streams destined for the UE **650**. If multiple spatial streams are destined for the UE **650**, they may be combined by the RX processor **656** into a single OFDM symbol stream. The RX processor **656** then converts the OFDM symbol stream from the time-domain to the frequency domain using a Fast Fourier Transform (FFT). The frequency domain signal comprises a separate OFDM symbol stream for each subcarrier of the OFDM signal. The symbols on each subcarrier, and the reference signal, is recovered and demodulated by determining the most likely signal constellation points transmitted by the eNB **610**. These soft decisions may be based on channel estimates computed by the channel estimator **658**. The soft decisions are then decoded and deinterleaved to recover the data and control signals that were originally transmitted by the eNB **610** on the physical channel. The data and control signals are then provided to the controller/processor **659**.

The controller/processor **659** implements the L2 layer. The controller/processor can be associated with a memory **660** that stores program codes and data. The memory **660** may be referred to as a computer-readable medium. In the UL, the control/processor **659** provides demultiplexing between transport and logical channels, packet reassembly, deciphering, header decompression, control signal processing to recover upper layer packets from the core network. The upper layer packets are then provided to a data sink **662**, which represents all the protocol layers above the L2 layer. Various control signals may also be provided to the data sink **662** for L3 processing. The controller/processor **659** is also responsible for error detection using an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support HARQ operations.

In the UL, a data source **667** is used to provide upper layer packets to the controller/processor **659**. The data source **667** represents all protocol layers above the L2 layer. Similar to the functionality described in connection with the DL transmission by the eNB **610**, the controller/processor **659** implements the L2 layer for the user plane and the control plane by providing header compression, ciphering, packet segmentation and reordering, and multiplexing between logical and transport channels based on radio resource allocations by the eNB **610**. The controller/processor **659** is also responsible for HARQ operations, retransmission of lost packets, and signaling to the eNB **610**.

Channel estimates derived by a channel estimator **658** from a reference signal or feedback transmitted by the eNB **610** may be used by the TX processor **668** to select the appropriate coding and modulation schemes, and to facilitate spatial processing. The spatial streams generated by the TX processor **668** are provided to different antenna **652** via separate transmitters **654**TX. Each transmitter **654**TX modulates an RF carrier with a respective spatial stream for transmission.

The UL transmission is processed at the eNB **610** in a manner similar to that described in connection with the receiver function at the UE **650**. Each receiver **618**RX receives a signal through its respective antenna **620**. Each receiver **618**RX recovers information modulated onto an RF carrier and provides the information to a RX processor **670**. The RX processor **670** may implement the L1 layer.

The controller/processor **675** implements the L2 layer. The controller/processor **675** can be associated with a memory **676** that stores program codes and data. The memory **676** may be referred to as a computer-readable medium. In the UL, the control/processor **675** provides demultiplexing between transport and logical channels, packet reassembly, deciphering, header decompression, control signal processing to recover upper layer packets from the UE **650**. Upper layer packets from the controller/processor **675** may be provided to the core network. The controller/processor **675** is also responsible for error detection using an ACK and/or NACK protocol to support HARQ operations.

FIG. **7** is a diagram **700** illustrating a range expanded cellular region in a heterogeneous network. A lower power class eNB such as the RRH **710***b* may have a range expanded cellular region **703** that is expanded from the cellular region **702** through enhanced inter-cell interference coordination between the RRH **710***b* and the macro eNB **710***a* and through interference cancellation performed by the UE **720**. In enhanced inter-cell interference coordination, the RRH **710***b* receives information from the macro eNB **710***a* regarding an interference condition of the UE **720**. The information allows the RRH **710***b* to serve the UE **720** in the range expanded cellular region **703** and to accept a handoff of the UE **720** from the macro eNB **710***a* as the UE **720** enters the range expanded cellular region **703**.

FIG. **8** is a drawing of an exemplary peer-to-peer communications system **800**. The peer-to-peer communications system **800** includes a plurality of wireless devices **806**, **808**, **810**, **812**. The peer-to-peer communications system **800** may overlap with a cellular communications system, such as for example, a wireless wide area network (WWAN). Some of the wireless devices **806**, **808**, **810**, **812** may communicate together in peer-to-peer communication, some may communicate with the base station **804**, and some may do both. For example, as shown in FIG. **8**, the wireless devices **806**, **808** are in peer-to-peer communication and the wireless devices **810**, **812** are in peer-to-peer communication. The wireless device **812** is also communicating with the base station **804**.

The wireless device may alternatively be referred to by those skilled in the art as user equipment (UE), a mobile station, a subscriber station, a mobile unit, a subscriber unit, a wireless unit, a wireless node, a remote unit, a mobile device, a wireless communication device, a remote device, a mobile subscriber station, an access terminal, a mobile terminal, a wireless terminal, a remote terminal, a handset, a user agent, a mobile client, a client, or some other suitable terminology. The base station may alternatively be referred to by those skilled in the art as an access point, a base transceiver station, a radio base station, a radio transceiver, a transceiver function, a basic service set (BSS), an extended service set (ESS), a Node B, an evolved Node B, or some other suitable terminology.

The exemplary methods and apparatuses discussed infra may be applicable to any of a variety of wireless peer-to-peer communications systems, such as for example, a wireless peer-to-peer communication system based on FlashLinQ, WiMedia, Bluetooth, ZigBee, or Wi-Fi based on the IEEE 802.11 standard.

FIG. **9**A is a first diagram **960** for illustrating an exemplary connection scheduling signaling scheme for wireless devices. As shown in FIG. **9**A, wireless device A is communicating with wireless device B, wireless device C is communicating with wireless device D, and wireless device E is communicating with wireless device F. The wireless device A is assumed to have transmit priority over the wireless device B, the wireless device C is assumed to have transmit priority over the wireless device D, and the wireless device E is assumed to have transmit priority over the wireless device F. Each of the links has a different medium access priority depending on the particular slot for communication. For the particular slot for communication, link 1 (A, B) is assumed to have a medium access priority of 2, link 2 (C, D) is assumed to have a medium access priority of 1, and link 3 (E, F) is assumed to have a medium access priority of 7.

FIG. **9**B is a second diagram **970** for illustrating an exemplary connection scheduling signaling scheme for the wireless devices. FIG. **9**B shows connection scheduling resources of first respective OFDM symbols of Txp, Tx, and Rx subblocks in a block corresponding to medium access priorities 1 through k in a connection scheduling subchannel. The connection scheduling resources include a plurality of subcarriers, each of the subcarriers corresponding to one of k frequency bands. Each of the frequency bands corresponds to a particular medium access priority. One block in the connection scheduling resources is split into three subblocks/phases: Txp, Tx, and Rx. The Txp-block is used by the node with transmit priority in the link to indicate whether the node with transmit priority will act as a transmitter or a receiver. If the node with transmit priority transmits on the allocated OFDM symbol in the Txp-block, the node with transmit priority indicates to the node without transmit priority an intent to act as a transmitter. If the node with transmit priority does not transmit on the allocated OFDM symbol in the Txp-block, the node with transmit priority indicates to the node without transmit priority an intent to act as a receiver. The Tx-block is used by potential transmitters to make a request to be scheduled. The transmitter transmits a direct power signal on the allocated OFDM symbol in the Tx-block at a power equal to a power used for the traffic channel (i.e., a power for transmitting the data segment). Each potential receiver listens to the tones in the Tx-blocks, compares the received power on each of the Tx-blocks to the received power on the Tx-block allocated to the transmitter of its own link, and determines whether to Rx-yield based on its own link medium access priority relative to other link medium access priorities and the comparison.

For example, assume the nodes A, D, and E transmit a transmit request signal in the Tx-block at a power equal to P_A, P_D, and P_E, respectively. The node B receives the transmit request signal from the node A at a power equal to $P_A|h_{AB}|^2$, where h_{AB} is the path loss between the node A and the node B. The node B receives the transmit request signal from the node D with a power equal to $P_D|h_{DB}|^2$, where h_{DB} is the path loss between the node D and the node B. The node B receives the transmit request signal from the node E with a power equal to $P_E|h_{EB}|^2$, where h_{EB} is the path loss between the node E and the node B. The node B compares the power of the received transmit request signal from the node A divided by the sum of the powers of the received transmit request signals from other nodes with a higher priority to a threshold in order to determine whether to Rx-yield. The node B does not Rx-yield if the node B expects a reasonable signal-to-interference ratio (SIR) if scheduled. That is, the node B Rx-yields unless $P_A|h_{AB}|^2/P_D/|h_{DB}|^2>\gamma_{RX}$, where γ_{RX} is the threshold (e.g., 9 dB).

The Rx-block is used by the potential receivers. If the receiver chooses to Rx-yield, the receiver does not transmit in the allocated OFDM symbol in the Rx-block; otherwise, the receiver transmits an inverse echo power signal in the allocated OFDM symbol in the Rx-block at a power proportional to an inverse of the power of the received direct power signal from the transmitter of its own link. All of the transmitters listen to the tones in the Rx-block to determine whether to Tx-yield transmission of the data segment.

For example, the node C, having received the transmit request signal from the node D at a power equal to $P_D|h_{DC}|^2$, transmits a transmit request response signal in the Rx-block at a power equal to $K/P_D|h_{DC}|^2$, where hoc is the path loss between the node D and the node C, and K is a constant known to all nodes. The node A receives the transmit request response signal from the node C at a power equal to $K|h_{CA}|^2/P_D|h_{DC}|^2$, where h_{CA} is the path loss between the node C and the node A. The node A Tx-yields if the node A would cause too much interference to the node C. That is, the node A Tx-yields unless $P_D|h_{DC}|^2/P_A|h_{CA}|^2>\gamma_{TX}$, where γ_{TX} is a threshold (e.g., 9 dB).

The connection scheduling signaling scheme is best described in conjunction with an example. The node C has no data to transmit and does not transmit in the Txp-block for medium access priority 1, the node A has data to transmit and transmits in the Txp-block for medium access priority 2, and the node E has data to transmit and transmits in the Txp-block for medium access priority 7. The node D has data to transmit and transmits in the Tx-block for medium access priority 1, the node A transmits in the Tx-block for medium access priority 2, and the node E transmits in the Tx-block for medium access priority 7. The node C listens to the tones in the Tx-blocks and determines to transmit in the Rx-block for medium access priority 1, as the node C has the highest priority. The node B listens to the tones in the Tx-blocks, determines that its link would not interfere with link 2, which has a higher medium access priority, and transmits in the Rx-block for medium access priority 2. The node F listens to the tones in the Tx-blocks, determines that its link would interfere with link 1 and/or link 2, both of which have a higher medium access priority, and Rx-yields by not transmitting in the Rx-block for medium access priority 7. Subsequently, both D and A listen to the tones in the Rx blocks to determine whether to transmit the data. Because D has a higher link medium access priority than A, D transmits its data. A will Tx-yield transmission of the data if A determines that its transmission would interfere with the transmission from D.

In a synchronous time division duplex (TDD) access network, such as a time division LTE (TD-LTE) femto network, uplink (UL) and downlink (DL) resource partitioning is global and semi-static. That is, all access points (APs) of such a network are synchronous and adhere to a global UL-DL resource partitioning pattern. This may cause inefficient resource utilization.

For example, FIG. **10** is a diagram **1000** illustrating a system wide UL-DL resource partitioning common to all APs of a synchronous TDD access network. As shown in FIG. **10**, the network is configured with 50% uplink resources and 50% downlink resources. However, if there is no uplink traffic for some of the APs of the network, the partitioned uplink resources are wasted. Similarly, if the traffic pattern changes over time, one of the two resources (i.e. uplink resources or downlink resources) will be overloaded while the other is under-utilized. The network resource configuration may be changed, but only on a slow time scale and requires coordination across all the APs in the network. The inefficient network resource configuration also leads to inefficient resource utilization throughout a system.

In an aspect, individual APs may dynamically choose their own UL-DL resource partitioning in order to adapt to changing traffic loads. As such, the AP (e.g., femto cell) may select its own UL-DL resource partitioning rather than a global partitioning common to all APs in a synchronous network. The selected UL-DL resource partitioning may be one of a set of predetermined UL-DL resource partitions. The selected UL-DL resource partitioning may be dynamically changed based on a traffic load (e.g., uplink traffic versus downlink traffic) and an interference environment (e.g., uplink/downlink traffic pattern of other APs nearby). The selected UL-DL partitioning may be communicated to other APs and UEs with which the AP communicates via a broadcast, for example.

During a resolution phase, for a given AP, a resource slot may be determined to be used for uplink or downlink. This may involve an expansion of the connection scheduling signaling scheme described supra with respect to FIGS. **9**A and **9**B, wherein all TxPs per UE are synchronized to the AP.

For example, for downlink resource slots, if the AP has data to transmit, the AP may signal its UEs in the resolution phase that the downlink resource slot will be used for downlink. However, if the AP does not have data to transmit, the AP may signal it's UEs in the resolution phase that the downlink resource slot will be used for uplink. The AP may also signal its UEs in the resolution phase that the downlink resource slot will be used for uplink if the AP determines that the downlink resource slot should necessarily be used for uplink, such as when there is a backlog of uplink traffic, for example.

In another example, for uplink resource slots, if the UE has data to transmit, the UE may signal its AP in the resolution phase that the uplink resource slot will be used for uplink. However, if the UE does not have data to transmit, the UE may signal it's AP in the resolution phase that the UE does not require the uplink resource slot for uplink. Moreover, if any of the UEs communicate to the AP a need for the uplink resource slot to remain for uplink, the uplink resource slot is used for uplink. Otherwise, the uplink resource slot is used for downlink.

Signaling whether a particular resource slot is to be used for uplink or downlink may be accomplished by transmitting a signal, or by refraining from transmitting a signal. For example, the AP may signal its desire to use the downlink resource slot for downlink by transmitting in a Txp slot of the resolution phase, or signal its desire not to use the downlink resource slot for downlink by refraining from transmitting in the Txp slot. The reverse may also be the case—for example, the AP may signal its desire to use the downlink resource slot for downlink by refraining from transmitting in the Txp slot of the resolution phase, or signal its desire not to use the downlink resource slot for downlink by transmitting in the Txp slot. The UE may also signal whether a particular resource slot is to be used for uplink or downlink by transmitting a signal, or by refraining from transmitting a signal, similar to the examples described above with respect to the AP.

Table 1 below provides an example of an AP UL-DL schedule.

TABLE 1

Uplink (U)-Downlink (D) Configuration	Downlink (D)-to-Uplink (U) Switch-point Periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

As shown in Table 1, uplink/downlink switching may be configured for 5 ms or 10 ms periods. Moreover, in the example, uplink transmissions occur after a switch (S) subframe.

FIG. **11** is a flow chart **1100** of a method of wireless communication for dynamically selecting uplink-downlink resource partitioning. The method may be performed by a UE. At step **1102**, the UE receives information from an access point (AP) indicating a partitioning between uplink and downlink resources. The information may be received via a broadcast signal transmitted from the AP. Moreover, the information received indicating the partitioning may be one partitioning of a set of partitionings, such as the set of partitionings depicted in Table 1 above. Also, the one partitioning may be different from a partitioning of a neighboring AP.

At step **1104**, the UE communicates with the AP to determine how a resource will be used. For example, the AP may communicate with the UE to determine if a downlink resource will be locally used for an uplink transmission. Alternatively, the UE may communicate with the AP to determine if an uplink resource will be used for a downlink transmission.

At step **1112**, the UE determines if the information received from the AP indicates that the resource is a downlink resource. If so, at step **1114**, the UE may further receive an indication from the AP that the downlink resource will be used for a downlink transmission. Accordingly, at step **1116**, the UE may receive a data transmission from the AP in the downlink resource.

Alternatively, at step **1114**, the UE may receive an indication from the AP that the downlink resource will be used for an uplink transmission. If so, at step **1116**, the UE may send a data transmission to the AP in the downlink resource.

At step **1118**, the UE determines if the information received from the AP indicates that the resource is an uplink resource. If so, at step **1120**, the UE may communicate an indication to the AP that the uplink resource will be used for an uplink transmission. Thereafter, at step **1122**, based on the indication communicated at step **1120**, the UE may send a data transmission to the AP in the uplink resource.

Alternatively, at step **1120**, the UE may communicate an indication to the AP that the uplink resource can be used for downlink transmission by the AP and in that case will be not used for an uplink transmission by the UE. Accordingly, at step **1124**, based on the indication communicated at step **1120**, the UE may further receive information from the AP indicating whether the uplink resource will be used for an uplink or downlink transmission. Thereafter, at step **1116**, the UE may receive a data transmission from the AP in the uplink resource, or the UE may send a data transmission to the AP in the uplink resource.

FIG. **12** is a flow chart **1200** of a method wireless communication. The method may be performed by a UE, and in connection with either of blocks **1116** and **1122** of FIG. **11**. In an aspect, the UE may determine whether to communicate in a resource with the AP according to a level of interference involved with the resource. Specifically, the UE may determine to communicate in the resource based on a first interference received from a link of another AP, or a second interference caused to the link of the other AP.

Accordingly, at step **1202**, the UE may determine if the first interference received from the link of the other AP is less than a first threshold. When the first interference received from the link of the other AP less than the first threshold, the UE may proceed to step **1204**. If not, the UE does not communicate in the resource with the AP. In an aspect, the determination of step **1202** may be performed by the AP and communicated to the UE.

At step **1204**, the UE may determine if the second interference caused to the link of the other AP is less than a second threshold. When the second interference caused to the link of the other AP is less than the second threshold, the UE may proceed to step **1206** and determine to communicate in the resource. Otherwise, the UE does not communicate in the resource with the AP. In an aspect, the determination of step **1204** may be performed by the AP and communicated to the UE.

FIG. **13** is a conceptual data flow diagram **1300** illustrating the data flow between different modules/means/components in an exemplary apparatus **1302**. The apparatus may be a UE. The apparatus **1302** includes a receiving module **1304**, a resource use determination module **1306**, a communication determination module **1308**, and a transmission module **1310**.

The receiving module **1304** receives information from an access point (AP) **1350** indicating a partitioning between uplink and downlink resources. The information may be received via a broadcast signal transmitted from the AP **1350**. Moreover, the information received indicating the partitioning may be one partitioning of a set of partitionings, such as the set of partitionings depicted in Table 1 above. Also, the one partitioning may be different from a partitioning of a neighboring AP.

The resource use determination module **1306** receives the information from the receiving module **1306**. Thereafter, the resource use determination module **1306** may communicate with the AP **1350** via the receiving module **1304** and/or the transmission module **1310** to determine how a resource will be used. Specifically, the resource use determination module **1306** may communicate with the AP **1350** to determine if a downlink resource will be used for an uplink transmission. Alternatively, the resource use determination module **1306** may communicate with the AP **1350** to determine if an uplink resource will be used for a downlink transmission.

The resource use determination module **1306** may determine if the information received from the AP **1350** indicates that the resource is a downlink resource. If so, the resource use determination module **1306** may further receive an indication from the AP **1350** that the downlink resource will be used for a downlink transmission. Accordingly, the resource use determination module **1306** may receive a data transmission from the AP **1350** in the downlink resource via the receiving module **1304**.

Alternatively, the resource use determination module **1306** may receive an indication from the AP **1350** that the downlink resource will be used for an uplink transmission. If so, the resource use determination module **1306** may send a data transmission to the AP **1350** in the downlink resource via the transmission module **1310**.

The resource use determination module **1306** may determine if the information received from the AP **1350** indicates that the resource is an uplink resource. If so, the resource use determination module **1306** may communicate an indication to the AP **1350** that the uplink resource will be used for an uplink transmission. Thereafter, based on the indication communicated, the resource use determination module **1306** may send a data transmission to the AP **1350** in the uplink resource via the transmission module **1310**.

Alternatively, the resource use determination module **1306** may communicate an indication to the AP **1350** that the uplink resource will be not used for an uplink transmission by the apparatus **1302**. Accordingly, based on the indication communicated, the resource use determination module **1306** may further receive information from the AP **1350**, via the receiving module **1304**, indicating whether the uplink resource will be used for an uplink or downlink transmission.

In an aspect, the communication determination module **1308** may determine whether to communicate in a resource with the AP **1350** according to a level of interference involved with the resource. Specifically, the communication determination module **1308** may determine to communicate in the resource based on a first interference received from a link of another AP, or a second interference caused to the link of the other AP.

Accordingly, the communication determination module **1308** may determine if the first interference received from the link of the other AP is less than a first threshold. When the first interference received from the link of the other AP is less than the first threshold, the communication determination module **1308** may proceed to determine if the second interference caused to the link of the other AP is less than a second threshold. If the first interference received from the link of the other AP is not less than the first threshold, the apparatus **1302** does not communicate in the resource with the AP **1350**. In an aspect, the determination may be performed by the AP **1350** and communicated to the communication determination module **1308** via the receiving module **1304**.

When the second interference caused to the link of the other AP is less than the second threshold, the communication determination module **1308** determines to communicate in the resource. Otherwise, the apparatus **1302** does not communicate in the resource with the AP **1350**. In an aspect, the determination may be performed by the AP **1350** and communicated to the communication determination module **1308** via the receiving module **1304**.

The apparatus may include additional modules that perform each of the steps of the algorithm in the aforementioned flow charts FIGS. **11** and **12**. As such, each step in the aforementioned flow charts FIGS. **11** and **12** may be performed by a module and the apparatus may include one or more of those modules. The modules may be one or more hardware components specifically configured to carry out the stated processes/algorithm, implemented by a processor configured to perform the stated processes/algorithm, stored within a computer-readable medium for implementation by a processor, or some combination thereof.

FIG. **14** is a diagram illustrating an example of a hardware implementation for an apparatus **1302'** employing a processing system **1414**. The processing system **1414** may be implemented with a bus architecture, represented generally by the bus **1424**. The bus **1424** may include any number of interconnecting buses and bridges depending on the specific application of the processing system **1414** and the overall design constraints. The bus **1424** links together various circuits including one or more processors and/or hardware modules, represented by the processor **1404**, the modules **1304**, **1306**, **1308**, **1310**, and the computer-readable medium **1406**. The bus **1424** may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further.

The processing system **1414** may be coupled to a transceiver **1410**. The transceiver **1410** is coupled to one or more antennas **1420**. The transceiver **1410** provides a means for communicating with various other apparatus over a transmission medium. The processing system **1414** includes a processor **1404** coupled to a computer-readable medium **1406**. The processor **1404** is responsible for general processing, including the execution of software stored on the computer-readable medium **1406**. The software, when executed by the processor **1404**, causes the processing system **1414** to perform the various functions described supra for any particular apparatus. The computer-readable medium **1406** may also be used for storing data that is manipulated by the processor **1404** when executing software. The processing system further includes at least one of the modules **1304**, **1306**, **1308**, and **1310**. The modules may be software modules running in the processor **1404**, resident/stored in the computer readable medium **1406**, one or more hardware modules coupled to the processor **1404**, or some combination thereof. The processing system **1414** may be a component of the UE **650** and may include the memory **660** and/or at least one of the TX processor **668**, the RX processor **656**, and the controller/processor **659**.

In one configuration, the apparatus **1302/1302'** for wireless communication includes means for receiving information indicating a partitioning between uplink and downlink resources, means for communicating with an access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink, means for determining whether to communicate in a resource with the access point based on at least one of a first interference received from a link of another access point or a second interference caused to the link of the another access point, means for communicating in the resource with the access point when at least one of the first interference is less than a first threshold or the second interference is less than a second threshold, means for receiving a data transmission from the access point in the downlink resource, means for sending a data transmission to the access point in the downlink resource, means for sending a data transmission to the access point in the uplink resource, and means for receiving information from the access point indicating whether the uplink resource will be used for uplink or downlink.

The aforementioned means may be one or more of the aforementioned modules of the apparatus **1302** and/or the processing system **1414** of the apparatus **1302'** configured to perform the functions recited by the aforementioned means. As described supra, the processing system **1414** may include the TX Processor **668**, the RX Processor **656**, and the controller/processor **659**. As such, in one configuration, the aforementioned means may be the TX Processor **668**, the RX Processor **656**, and the controller/processor **659** configured to perform the functions recited by the aforementioned means.

It is understood that the specific order or hierarchy of steps in the processes disclosed is an illustration of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged. Further, some steps may be combined or omitted. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but is to be accorded the full scope consistent with the language claims, wherein reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed as a means plus function unless the element is expressly recited using the phrase "means for."

What is claimed is:

1. A method of wireless communication of a user equipment (UE), comprising:

receiving, by the UE, information indicating a partitioning between uplink and downlink resources from an access point, wherein the information allocates a first resource as a downlink resource or an uplink resource;

communicating, by the UE, with the access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink, including:

determining, by the UE, that the UE will not transmit data in the first resource when the first resource is allocated as an uplink resource; and

in response to the determination that the UE will not transmit data in the first resource:

transmitting, by the UE, to the access point an indication indicating that the UE will not transmit data in the first resource, and

allocating, by the UE, the first resource as a downlink resource.

2. The method of claim **1**, further comprising determining whether to communicate in the first resource with the access point based on at least one of a first interference received from a link of another access point or a second interference caused to the link of the another access point.

3. The method of claim **2**, further comprising communicating in the first resource with the access point when at least one of the first interference is less than a first threshold or the second interference is less than a second threshold.

4. The method of claim **1**, wherein the information received indicates the first resource is the downlink resource, and the communicating with the access point comprises receiving an indication from the access point that the downlink resource will be used for downlink.

5. The method of claim **4**, further comprising receiving a data transmission from the access point in the downlink resource.

6. The method of claim **1**, wherein the information received indicates the first resource is the downlink resource, and the communicating with the access point comprises receiving an indication from the access point that the downlink resource will be used for uplink.

7. The method of claim **6**, further comprising sending a data transmission to the access point in the downlink resource.

8. The method of claim **1**, wherein the information received indicates the first resource is the uplink resource, and the communicating with the access point comprises communicating an indication to the access point that the uplink resource will be used for uplink.

9. The method of claim **8**, further comprising sending a data transmission to the access point in the uplink resource.

10. The method of claim **1**, wherein the information received indicates the first resource is the uplink resource, and the communicating with the access point comprises communicating an indication to the access point that the uplink resource will not be used for uplink by the UE.

11. The method of claim **10**, further comprising receiving information from the access point indicating whether the uplink resource will be used for uplink or downlink.

12. The method of claim **1**, wherein the information received indicating the partitioning is one partitioning of a set of partitionings.

13. The method of claim **12**, wherein said one partitioning is different from a partitioning used by a neighboring access point.

14. An apparatus of wireless communication, the apparatus being a user equipment (UE), comprising:

means for receiving, by the UE, information indicating a partitioning between uplink and downlink resources from an access point, wherein the information allocates a first resource as a downlink resource or an uplink resource;

means for communicating, by the UE, with the access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink, wherein the means for communicating is configured to

determine, by the UE, that the UE will not transmit data in the first resource when the first resource is allocated as an uplink resource; and

in response to the determination that the UE will not transmit data in the first resource:

transmit, by the UE, to the access point an indication indicating that the UE will not transmit data in the first resource, and

allocate, by the UE, the first resource as a downlink resource.

15. The apparatus of claim **14**, further comprising means for determining whether to communicate in the first resource with the access point based on at least one of a first interference received from a link of another access point or a second interference caused to the link of the another access point.

16. The apparatus of claim **15**, further comprising means for communicating in the first resource with the access point when at least one of the first interference is less than a first threshold or the second interference is less than a second threshold.

17. The apparatus of claim **14**, wherein the information received indicates the first resource is the downlink resource, and the means for communicating with the access point is configured to receive an indication from the access point that the downlink resource will be used for downlink.

18. The apparatus of claim **17**, further comprising means for receiving a data transmission from the access point in the downlink resource.

19. The apparatus of claim **14**, wherein the information received indicates the first resource is the downlink resource, and the means for communicating with the access point is configured to receive an indication from the access point that the downlink resource will be used for uplink.

20. The apparatus of claim **19**, further comprising means for sending a data transmission to the access point in the downlink resource.

21. The apparatus of claim **14**, wherein the information received indicates the resource is the uplink resource, and the means for communicating with the access point is configured to communicate an indication to the access point that the uplink resource will be used for uplink.

22. The apparatus of claim **21**, further comprising means for sending a data transmission to the access point in the uplink resource.

23. The apparatus of claim **14**, wherein the information received indicates the first resource is the uplink resource, and the means for communicating with the access point is configured to communicate an indication to the access point that the uplink resource will not be used for uplink by the UE.

24. The apparatus of claim **23**, further comprising means for receiving information from the access point indicating whether the uplink resource will be used for uplink or downlink.

25. The apparatus of claim **14**, wherein the information received indicating the partitioning is one partitioning of a set of partitionings.

26. The apparatus of claim **25**, wherein said one partitioning is different from a partitioning used by a neighboring access point.

27. An apparatus for wireless communication, the apparatus being a user equipment (UE), comprising:

a memory;

at least one processor coupled to the memory and configured to:

receive, by the UE, information indicating a partitioning between uplink and downlink resources from an access point, wherein the information allocates a first resource as a downlink resource or an uplink resource;

communicate, by the UE, with the access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink, wherein to communicate with the access point, the at least one processor is configured to

determine, by the UE, that the UE will not transmit data in the first resource when the first resource is allocated as an uplink resource; and

in response to the determination that the UE will not transmit data in the first resource:

transmit, by the UE, to the access point an indication indicating that the UE will not transmit data in the first resource, and

allocate, by the UE, the first resource as a downlink resource.

28. The apparatus of claim **27**, wherein the at least one processor is further configured to determine whether to communicate in the first resource with the access point based on at least one of a first interference received from a link of another access point or a second interference caused to the link of the another access point.

29. The apparatus of claim **28**, wherein the at least one processor is further configured to communicate in the first resource with the access point when at least one of the first interference is less than a first threshold or the second interference is less than a second threshold.

30. The apparatus of claim **27**, wherein the information received indicates the first resource is the downlink resource, and the at least one processor configured to communicate with the access point is further configured to receive an indication from the access point that the downlink resource will be used for downlink.

31. The apparatus of claim **30**, wherein the at least one processor is further configured to receive a data transmission from the access point in the downlink resource.

32. The apparatus of claim **27**, wherein the information received indicates the first resource is the downlink resource, and the at least one processor configured to communicate with the access point is further configured to receive an indication from the access point that the downlink resource will be used for uplink.

33. The apparatus of claim **32**, wherein the at least one processor is further configured to send a data transmission to the access point in the downlink resource.

34. The apparatus of claim **27**, wherein the information received indicates the first resource is the uplink resource, and the at least one processor configured to communicate with the access point is further configured to communicate an indication to the access point that the uplink resource will be used for uplink.

35. The apparatus of claim **34**, wherein the at least one processor is further configured to send a data transmission to the access point in the uplink resource.

36. The apparatus of claim **27**, wherein the information received indicates the resource is the uplink resource, and the at least one processor configured to communicate with the access point is further configured to communicate an indication to the access point that the uplink resource will not be used for uplink by the UE.

37. The apparatus of claim **36**, wherein the at least one processor is further configured to receive information from the access point indicating whether the uplink resource will be used for uplink or downlink.

38. The apparatus of claim **27**, wherein the information received indicating the partitioning is one partitioning of a set of partitionings.

39. The apparatus of claim **38**, wherein said one partitioning is different from a partitioning used by a neighboring access point.

40. A non-transitory computer-readable medium storing computer executable code for wireless communication, comprising code for:

receiving, by a user equipment (UE), information indicating a partitioning between uplink and downlink resources from an access point, wherein the information allocates a first resource as a downlink resource or an uplink resource;

communicating, by the UE, with the access point to determine at least one of whether a downlink resource will be used for uplink or whether an uplink resource will be used for downlink, including:

determining, by the UE, that the UE will not transmit data in the first resource when the first resource is allocated as an uplink resource; and

in response to the determination that the UE will not transmit data in the first resource:

transmitting, by the UE, to the access point an indication indicating that the UE will not transmit data in the first resource, and

allocating, by the UE, the first resource as a downlink resource.

41. The method of claim **1**, wherein the transmission of the indication by the UE to the access point is performed in a resolution phrase of the first resource, wherein the communicating with the access point further comprises:

determining that an indication is received from the access point in the resolution phrase of the first resource when the first resource is allocated as a downlink resource, wherein the indication received from the access point indicates that the access point will not transmit data in the first resource; and

allocating the first resource as an uplink resource in response to determining that the indication is received from the access point.

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